

Water Resources Survey

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*McCone
County,
Montana*

Part I:

WATER AND RELATED LAND
RESOURCES

and

Part II:

IRRIGATION DEVELOPMENT WITH
MAPS SHOWING IRRIGATED AREAS
IN COLORS DESIGNATING
SOURCES OF SUPPLY

Published by

MONTANA WATER RESOURCES BOARD

Sam W. Mitchell Building

Helena, Montana 59601 — September, 1971

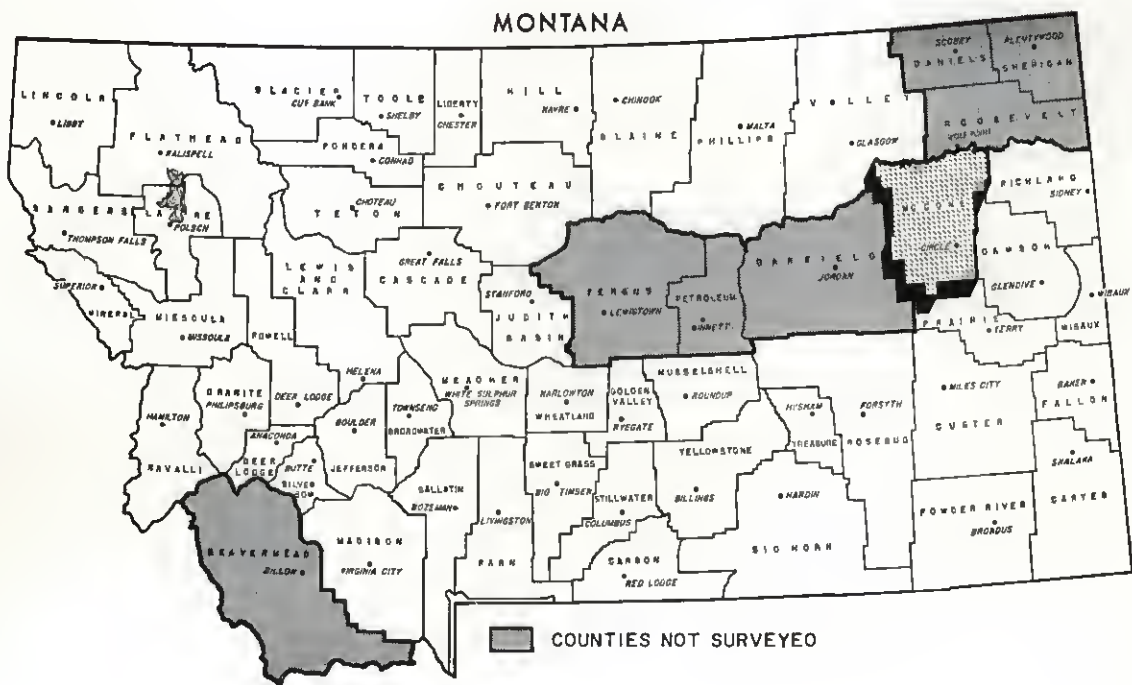
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McCONE COUNTY, MONTANA

PART I

Water and Related Land Resources



Published by
MONTANA WATER RESOURCES BOARD
Sam W. Mitchell Building
Helena, Montana 59601
September, 1971

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September 1, 1971

The Honorable Forrest H. Anderson
Governor of Montana
State Capitol Building
Helena, Montana

Dear Governor Anderson:

Submitted herewith is a consolidated report on a survey of Water Resources for McCone County, Montana.

The report is divided into two parts: Part I consists of history of land and water uses, and Part II contains the summary of water rights and irrigated lands, and the township maps in the County showing in colors the lands irrigated from each source of water supply.

Surveys have been made in the counties of Big Horn, Blaine, Broadwater, Carbon, Carter, Cascade, Chouteau, Custer, Dawson, Deer Lodge, Fallon, Flathead, Gallatin, Glacier, Golden Valley, Granite, Hill, Jefferson, Judith Basin, Lake, Lewis and Clark, Liberty, Lincoln, Madison, **McCone**, Meagher, Mineral, Missoula, Musselshell, Park, Phillips, Pondera, Powder River, Powell, Prairie, Ravalli, Richland, Rosebud, Sanders, Silver Bow, Stillwater, Sweet Grass, Teton, Toole, Treasure, Valley, Wibaux, Wheatland and Yellowstone. Reports are available for all of the counties except a few of the ones which were surveyed a number of years ago and are now out of print. However, reports will again be published on these counties sometime in the future after they have been updated. Copies of these Water Resources Survey reports are available upon request to the Montana Water Resources Board.

The office files contain minute descriptions and details of each individual water right and land use, which are too voluminous to be included herein. These office files are available for inspection to those who are interested.

The historical data on water rights contained in these reports can never become obsolete. If new information is added from time to time as new developments occur, the records can always be kept current and up-to-date.

Respectfully submitted,
DOUGLAS G. SMITH, Director
Montana Water Resources Board

ACKNOWLEDGMENTS

A survey and study of water resources involves many phases of both field and office work in order to gather the necessary data to make the information complete and comprehensive. Appreciation of the splendid cooperation of various agencies and individuals who gave their time and assistance in aiding us in gathering the data for the preparation of this report is hereby acknowledged.

Hans L. Bille.....Surface Water Rights Coordinator and Editor

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METHOD OF SURVEY

Water resources data contained in Part I and Part II of this report are obtained from courthouse records in conjunction with individual contacts with landowners. A survey of this type involves extensive detailed work in both the office and field to compile a comprehensive inventory of water rights as they apply to land and other uses.

The material of foremost importance used in conducting the survey is taken from the files of the county courthouse and the data required includes: landownership, water right records (decrees and appropriations), articles of incorporation of ditch companies and any other legal papers concerning the distribution and use of water. Deed records of landownership are reviewed and abstracts are checked for water right information when available.

Aerial photography is used by the survey to assure accuracy in mapping the land areas of water use and all the other detailed information which appears on the final colored township maps in Part II. Section and township locations are determined by the photogrammetric system, based on government land office survey plats, plane-table surveys, county maps and by "on-the-spot" location during the field survey. Noted on the photographs is the location of each irrigation system, with the irrigated and irrigable land areas defined. All the information compiled on the aerial photo is transferred and drawn onto a final base map by means of aerial projection. From the base map, color separation maps are made and may include three to ten overlay separation plates, depending on the number of irrigation systems within the township.

Field forms are prepared for each landowner showing the name of the owner and operator, photo index number, a plat defining the ownership boundary, type of irrigation system, source of water supply and the total acreage irrigated and irrigable under each. All of the appropriated and decreed water rights that apply to each ownership are listed on the field forms with the description of intended place of use. During the field survey, all water rights listed on the field form are verified with the landowner. Whenever any doubt or complication exists in the use of a water right, deed records of the land are checked to determine the absolute right and use.

So far as known, this is the first survey of its kind ever attempted in the United States. The value of the work has become well substantiated in the counties completed to date by giving Montana its first accurate and verified information concerning its water rights and their use. New development of land for irrigation purposes by State and Federal agencies is not within the scope of this report. The facts presented are found at the time of completion of each survey and provide the items and figures from which a detailed analysis of water and land use can be made.

The historical data contained in these reports can never become obsolete. If new information is added from time to time as new developments occur, the records can always be kept current and up-to-date.

Complete data obtained from this survey cannot be included in this report as it would make the text too voluminous. However, if one should desire detailed information about any particular water right, lands irrigated, or the number and amount of water rights diverting from any particular stream, such information may be obtained by writing the Montana Water Resources Board in Helena.

Every effort is being made to ensure accuracy of the data collected rather than to speed up the work which might invite errors.

SURFACE WATER RIGHTS

Our concern over surface water rights in Montana is more than a century old. When the first Territorial Legislature, meeting in Bannack, adopted the common law of England on January 11, 1865, the Territory's legal profession assumed that it had adopted the Doctrine of Riparian Rights. This doctrine had evolved in England and in the eastern United States where the annual rainfall is generally more than twenty inches. It gave the owners of land bordering a stream the right to have that stream flow past their land undiminished in quantity and unaltered in quality and to use it for household and livestock purposes. The law restricted the use of water to riparian owners and forbade them to reduce appreciably the stream flow, but the early miners and ranchers in Montana favored the Doctrine of Prior Appropriation which permitted diversion and diminution of the streams. Consequently, the next day the legislature enacted another law which permitted diversion by both riparian and non-riparian owners. Whether or not this action provided Montana with one or two definitions of water rights was not settled until 1921 when the Montana Supreme Court in the *Mettler vs. Ames Realty* case declared the Doctrine of Prior Appropriation to be the valid Montana water right law. "Our conclusion," it said, "is that the common law doctrine of riparian rights has never prevailed in Montana since the enactment of the Bannack Statutes in 1865 and that it is unsuited to the conditions here . . ."

The appropriation right which originated in California was used by the forty-niners to divert water from the streams to placer mine gold. They applied to the water the same rules that they applied to their mining claims—first in time, first in right and limitation of the right by beneficial use. Those who came to Montana gulches brought with them these rules, applying them to agriculture as well as to mining.

The main points of consideration under the Doctrine of Prior Appropriation are:

1. The use of water may be acquired by both riparian and non-riparian landowners.
2. It allows diversion of water regardless of the reduction of the water supply in the stream.
3. The value of the right is determined by the priority of the appropriation; i.e., first in time is first in right.
4. The right is limited to the use of the water. Stream waters in Montana are considered to be the property of the State and the appropriator acquires only a right to their use. Moreover, this use must be beneficial.
5. A right to the use of water is considered property only in the sense that it can be bought or sold; its owner may not be deprived of it except by due process of law.

The State Legislature has provided methods for the acquisition, determination of priority and administration of the right. No right may be acquired on a stream without diversion of water and its application to a beneficial use. On unadjudicated streams, the Statutes stipulate that the diversion must be preceded by posting a notice at a point of intended diversion and by filing a copy of it within 20 days in the county clerk's office of the county in which the appropriation is being made. Construction of the means of diversion must begin within 40 days of the posting and continued with reasonable diligence to completion (Section 89-810 R.C.M. 1947). However, the Mon-

tana Supreme Court has ruled that an appropriator who fails to comply with the Statutes may still acquire a right merely by digging a ditch and putting the water to beneficial use.

To obtain a water right on an adjudicated stream one must petition the District Court having jurisdiction over the stream for permission to make an appropriation. If the other appropriators do not object, the court gives its consent and issues a supplementary decree granting the right subject to the rights of the prior appropriators.

Montana laws do not require water users to file official records of the completion of their appropriations; therefore, it becomes advisable as soon as the demand for the waters of a stream becomes greater than its supply, to determine the rights and priorities of each user by means of an adjudication or water right suit. This action may be initiated by one or more of the appropriators who may make all the other claimants parties to the suit. The Judge of the District Court then examines all of the claims and issues a decree establishing priority of the right of each water user and the amount of water he is entitled to use. The court decree becomes in effect the deed of the appropriator to his water right.

Whenever scarcity of water in an adjudicated stream requires an allocation of the supply according to the priority of rights, the Judge, upon petition of the owners of at least 15 percent of the water rights affected, must appoint a water commissioner to distribute the water. Chapter No. 231, Montana Session Laws 1963, Senate Bill 55 amended Section 89-1001 R.C.M. 1947, to provide that a water commissioner be appointed to distribute decreed water rights by application of 15 percent of the owners of the water rights affected, or, under certain circumstances at the discretion of the Judge of the District Court—**"provided that when petitioners make proper showing they are not able to obtain the application of the owners of a least 15 percent of the water rights affected, and they are unable to obtain the water to which they are entitled, the Judge of the District Court having jurisdiction may, in his discretion, appoint a water commissioner."** After the Commissioner has been appointed the Judge gives his instructions on how the water is to be apportioned and distributed in accordance with the full terms of the decree.

The recording of appropriations in local courthouses provides an incomplete record of the water rights on unadjudicated streams. In fact, the county records often bear little relation to the existing situation. Since the law places no restriction on the number or extent of the filings which may be made on an unadjudicated stream, the total amount of water claimed is frequently many times the available flow. There are numerous examples of streams becoming over appropriated. Once six appropriators each claimed all the water in Lyman Creek near Bozeman. Before the adjudication of claims to the waters of Prickley Pear Creek, 68 parties claimed thirty times its average flow of about 50 c.f.s. Today, the Big Hole River with an average flow of about 1,000 c.f.s. has filings totaling 173,912 c.f.s. One is unable to distinguish in the county courthouse the perfected rights from the unperfected ones since the law requires no official recording of the completion of an appropriation. Recognition by the courts of unrecorded appropriations adds to the incompleteness of these records. To further complicate the situation, appropriators have used different names for the same stream in their filings. In Montana, many of the streams flow through several counties; consequently, water right filings on those inter-county streams are found distributed in two or more county courthouses. Anyone desirous of determining appropriations on a certain river or creek finds it difficult and expensive to examine records in several places. In addition, the records are sometimes scattered because the original nine counties of 1865 have now increased to 56. As the original counties have been divided and subdivided, the water right filings have frequently not been transcribed from the

records of one county to the other. Thus, a record of an early appropriation in what is at present Powell County may be found in the courthouse of the original Deer Lodge County.

It can readily be seen that this system of recording offers little protection to rights in the use of water until they are determined by adjudication. In other words, an appropriator does not gain clear title to his water right until after adjudication, and then the title may not be clear because the Montana system of determining rights is also faulty. In the first place, adjudications are costly, sometimes extremely costly when they are prolonged for years. It is estimated that litigation over the Beaverhead River, which has lasted more than twenty years, has cost the residents of the valley nearly one-half million dollars. In the second place, unless the court seeks the advice of a competent irrigation engineer, the adjudication may be based upon inaccurate evidence; in the third place, if some claimant has been inadvertently left out of the action, the decree is not final and may be reopened for consideration by the aggrieved party. Another difficulty arises in determining the ownership of a water right when land under an adjudicated stream becomes subdivided in later years and the water is not apportioned to the land by deed or otherwise. There are no provisions made by law requiring the recording of specific water right ownership on deeds and abstracts.

The Legislative Session of 1957 passed Chapter 114 providing for the policing of water released from storage to be transmitted through a natural stream bed to the place of use. The owner of the storage must petition the court for the right to have the water policed from the storage reservoir to his place of use. If there are no objections the court may issue the right and appoint a water commissioner to distribute the water in accordance therewith. This law applies only to unadjudicated streams.

Administration of water on adjudicated streams is done by the District Court, but it has its drawbacks. The appointment of a water commissioner is often delayed until the shortage of water is acute and the court frequently finds it difficult to obtain a competent appointee for so temporary a position. The present administration of adjudicated streams which cross the county boundaries of judicial districts creates problems. Many of the water decrees stipulate head gates and measuring devices for proper water distribution, but in many instances the stipulation is not enforced, causing disagreement among water users.

Since a water right is considered property and may be bought and sold, the nature of water requires certain limitations in its use. One of the major difficulties encountered after an adjudication of a stream is the failure of the District Court to have control over the transfer of water rights from their designated places of use. The sale and leasing of water is becoming a common practice on many adjudicated streams and has created serious complications. By changing the water use to a different location, many of the remaining rights along the stream are disrupted, resulting in a complete breakdown of the purpose intended by the adjudication. Legal action necessary to correct this situation must be initiated by the injured parties as it is their responsibility and not that of the court.

In 1967, the Montana Legislative Assembly passed Section (89-813) Water Laws of Montana which states: "From and after July 1, 1967, the county clerk and recorder shall forward to the Montana Water Resources Board a copy of an instrument of water appropriation or any instrument transferring any water appropriation which is filed as provided in this section."

This means that copies of **all surface water filings** (appropriations) and copies of **all deed transfers** of water appropriations filed in the office of the county clerk and recorder on or after July 1,

1967, are to be forwarded to the Montana Water Resources Board, Sam W. Mitchell Building, Helena, Montana 59601.

At one time or another all of the Western Reclamation States have used similar methods of local regulation of water rights. Now all of them, except Montana, have more or less abandoned these practices and replaced them by a system of centralized state control such as the one adopted by the State of Wyoming. The key characteristics of the Wyoming system are the registration of both the initiation and completion of an appropriation in the State Engineer's office, the determination of rights and administration by a State Board of Control headed by the State Engineer. These methods give the Wyoming water users title to the use of water as definite and defensible as those which they have to their land.

When Montana began to negotiate the Yellowstone River Compact with Wyoming and North Dakota in 1939, the need for some definite information concerning our water and its use became apparent. The Legislature in 1939 passed a bill (Ch. 185) authorizing the collection of data pertaining to our uses of water and it is under this authority that the Water Resources Survey is being carried on. The purpose of this survey is: (1) to catalogue by counties in the office of the Montana Water Resources Board, all recorded, appropriated, and decreed water rights including the use rights as they are found; (2) to map the lands upon which the water is being used; (3) to provide the public with pertinent water right information on any stream, thereby assisting in any transaction involving water; (4) to help State and Federal agencies in pertinent matters; (5) to eliminate unnecessary court action in water right disputes; and (6) to have a complete inventory of our perfected water rights in case of need to defend these rights against the encroachments of downstream states, or Wyoming or Canada.

GROUNDWATER RIGHTS

Groundwater and surface water are often intimately related. In fact, it is difficult in some cases to consider one without the other. In times of heavy precipitation and surface runoff, water seeps below the land surface to recharge underground reservoirs which, in turn, discharge groundwater to streams and maintain their flow during dry periods. The amount of water stored underground is far greater than the amount of surface water in Montana, and without seepage from underground sources, it is probable that nearly all the streams in the state would cease to flow during dry periods.

It is believed that Montana's groundwater resources are vast and only partially developed, yet this resource is now undergoing accelerated development as the need for its use increases and economical energy for pumping becomes available. Continued rapid development without some regulation of its use would cause a depletion of groundwater in areas where the recharge is less than the withdrawal. Experience in other states has shown that once excessive use of groundwater in a specific area has started, it is nearly impossible to stop and may result in painful economic readjustments for the inhabitants of the affected area.

Practical steps aimed at conserving groundwater resources as well as correcting related deficiencies in surface water laws became necessary in Montana. Prior to the Legislative Session of 1961, there was no legal method of appropriating groundwater. Proposed groundwater codes were introduced and rejected in four biennial sessions of the Montana Legislative Assembly—1951, 1953, 1955 and 1959.

In 1961, during the 37th Legislative Session, a bill was introduced and passed creating a Groundwater Code in Montana (Chapter 237, Revised Codes of Montana, 1961). This bill became effective as a law on January 1, 1962, with the State Engineer of Montana designated as "Administrator" to carry out provisions of the Act. However, the 1965 Legislature abolished the office of the State Engineer and transferred his duties to the State Water Conservation Board, effective July 1, 1965. On July 1, 1967, the name of the State Water Conservation Board was changed to the Montana Water Resources Board. Therefore, the Montana Water Resources Board became the "Administrator" of this Act.

Some of the important provisions contained in Montana's Groundwater Law are:

Section 1. DEFINITIONS OR REGULATIONS AS USED IN THIS ACT.

(a) "Groundwater" means any fresh water under the surface of the land including the water under the bed of any stream, lake, reservoir, or other body of surface water. Fresh water shall be deemed to be the water fit for domestic, livestock, or agricultural use. The Administrator, after a notice of hearing, is authorized to fix definite standards for determining fresh water in any controlled groundwater area or subarea of the State.

(b) "Aquifer" means any underground geological structure or formation which is capable of yielding water or is capable of recharge.

(c) "Well" means any artificial opening or excavation in the ground, however made, by which groundwater can be obtained or through which it flows under natural pressures or is artificially withdrawn.

(d) "Beneficial use" means any economically or socially justifiable withdrawal or utilization of water.

(e) "Person" means any natural person, association, partnership, corporation, municipality, irrigation district, the State of Montana, or any political subdivision or agency thereof, and the United States or any agency thereof.

(f) "Administrator" means the Montana Water Resources Board of the State of Montana.

(g) "Groundwater area" means an area which, as nearly as known facts permit, may be designated so as to enclose a single distinct body of groundwater, which shall be described horizontally by surface description in all cases and which may be limited vertically by describing known geological formations, should conditions dictate this to be desirable. For purpose of administration, large groundwater areas may be divided into convenient administrative units known as "subareas." (The remaining definitions were added during the 1971 Legislative Session.)

(h) "Notice of appropriation" means an optional form on which the appropriator notifies the administrator and files for record the intention to appropriate ground water. This form filed alone does not give the appropriator the right to use ground water. It must be followed by a notice of completion to establish a right.

(i) "Notice of completion" means a form on which the appropriator notifies the administrator and files for record the completion of a well (notice of completion of ground water appropriation by

means of well) or the completion of a development to withdraw ground water without a well as by subirrigation and other natural processes (notice of completion of ground water appropriation without a well).

(j) "Declaration of vested ground water rights" means a form which was provided, for a period of four (4) years after January 1, 1962, for filing vested ground water rights. This form expired on January 1, 1966.

Section 2. RIGHT TO USE.

Rights to surface water where the date of appropriation precedes January 1, 1962, shall take priority over all prior or subsequent groundwater rights. The application of groundwater to a beneficial use prior to January 1, 1962, is hereby recognized as a water right. Beneficial use shall be the extent and limit of the appropriative right. As to appropriations of groundwater completed on and after January 1, 1962, any and all rights must be based upon the filing provisions hereinafter set forth, and as between all appropriators of surface water or groundwater on and after January 1, 1962, the first in time is first in right.

Montana's Groundwater Code now provides for three different types of forms available for filing water rights, depending upon the nature of the groundwater development. The use of GW-4, Declaration of Vested Groundwater Rights, expired January 1, 1966.

Form GW-1, "**Notice of Appropriation of Groundwater**"—shall require answers to such questions as (1) the name and address of the appropriator; (2) the beneficial use for which the appropriation is made, including a description of the lands to be benefited if for irrigation; (3) the rate of use in gallons per minute of groundwater claimed; (4) the annual period (inclusive dates) of intended use; (5) the probable or intended date of first beneficial use; (6) the probable or intended date of commencement and completion of the well or wells; (7) the location, type, size, and depth of the well or wells contemplated; (8) the probable or estimated depth of the water table or artesian aquifer; (9) the name, address and license number of the driller engaged; and (10) such other similar information as may be useful in carrying out the policy of this Act. This form is optional but it has an advantage in that after filing the Notice of Appropriation, a person has 90 days in which to commence actual excavation and diligently prosecute construction of the well. Otherwise, failure to file the Notice of Appropriation deprives the appropriator of his right to relate the date of the appropriation back upon filing the Notice of Completion.

Form GW-2, "**Notice of Completion of Groundwater Appropriation by Means of Well**"—this form shall require answers to the same sort of questions as required by Form GW-1 (Notice of Appropriation of Groundwater), except that for the most part it shall inquire into accomplished facts concerning the well or means of withdrawal, including (a) information as to the static level of water in the casing or the shut-in pressure if the well flows naturally; (b) the capacity of the well in gallons per minute by pumping or natural flow; (c) the approximate drawdown or pumping level of the well; (d) the approximate surface elevation at the well head; (e) the casing record of the well; (f) the drilling log showing the character and thickness of all formations penetrated; (g) the depth to which the well is drilled and similar information.

It shall be the responsibility of the driller of each well to fill out the Form GW-2, "Notice of Completion of Groundwater Appropriation by Means of Well," for the appropriator, and the latter shall be responsible for its filing.

Form GW-3, "Notice of Completion of Groundwater Appropriation Without Well"—is for the benefit of persons obtaining (or desiring to obtain) groundwater without a well, such as by sub-irrigation or other natural processes so as to enable such persons to describe the means of using groundwater; to estimate the amount of water so used; and requiring such other information pertinent to this particular type of groundwater appropriation.

Montana's Groundwater Code provided for a period of four (4) years after January 1, 1962, for filing vested groundwater rights. The deadline for filing was December 31, 1965. A person did not automatically lose his vested groundwater rights by failure to file within the four-year period, but in the event of a future groundwater dispute, he would bear the burden of proving his rights in court.

The 1971 Legislative Session amended a section of the Groundwater Code, stating that, any person desiring to file on groundwater put to beneficial use prior to January 1, 1962, but not filed on by December 31, 1965, may file a "notice of completion". The appropriators right will commence on the date the notice is filed, except as otherwise provided in the Groundwater Code.

It shall be recognized that all persons who have filed a Water Well Log Form as provided for under Sections 1 and 2 of Chapter 58, Session Laws of Montana, 1957, shall be considered as having complied with the requirements of this Act.

It is important to note that the groundwater law states, "UNTIL A NOTICE OF COMPLETION (Form GW-2 or GW-3) IS FILED WITH RESPECT TO ANY USE OF GROUNDWATER INSTITUTED AFTER JANUARY 1, 1962, NO RIGHT TO THAT USE OF WATER SHALL BE RECOGNIZED".

Copies of the forms used in filing on groundwater are available in the County Clerk and Recorder's Office in each of Montana's 56 counties. It shall be the duty of the County Clerk in every instance to record and file the original copy of the appropriation, transmit the second copy to the Administrator (Montana Water Resources Board) and the third copy to the Montana Bureau of Mines and Geology. A fourth copy is to be retained by the appropriator (person making the filing).

An accurate method of compiling data on the amount of water being used and the amount of water available for future use is essential in the administration and investigation of water resources. In areas where the water supply becomes critical, the groundwater law provides that the Administrator may define the boundaries of the aquifer and employ inspectors to enforce rules and regulations regarding withdrawals for the purpose of safeguarding the water supply and the rights of the appropriators. (See wording of the law for establishing a "controlled area".)

The filing of water right records in a central office under control of a responsible State agency provides an efficient means for the orderly development and preservation of our water supplies while protecting all appropriators.

HISTORY AND ORGANIZATION

Early settlement and development in the present area of McCone County came at a much later date than in other counties in Montana. This condition existed mainly because of the rugged terrain and the white man's designation of the area as "Indian Country". All of the country between the Missouri and Yellowstone Rivers was a natural habitat for thousands of game animals, and until about 1880, the common hunting ground of all Indian tribes.

Large herds of buffalo roamed the area which is now McCone County until the early 1880's when the buffalo hunters had taken more than a million hides. This slaughter of the buffalo left the range open for the big cattle ranchers to move in with their herds.

One of the largest and most important ranches established in the McCone County area was the N-N. The N-N Cattle Ranch was formed by the Neidringhaus brothers of St. Louis, Missouri, in 1884. The N-N was also known as Home Land & Cattle Company.

In 1884, the Neidringhaus brothers took over, on a debt, 6,000 head of cattle and purchased the H3 horse ranch from Hunter and Evans. The H3 ranch was located just over the southwest line of what is now McCone County, and was the first headquarters ranch of N-N in Montana. In the fall of 1884 the N-N trailed their cattle west to the vicinity of Deer Lodge; however, the following winters of 1885-86 and 1886-87 were disastrous to the herd and the N-N suffered heavy losses. These bad winters and heavy losses did not discourage the Neidringhaus brothers and in 1887 they established a new headquarters ranch on Prairie Elk Creek near its junction with the Missouri.

The largest part of the N-N herd ranged between the Yellowstone and Missouri Rivers, with some ranging as far south as the Musselshell River. The greatest number of cattle the N-N ran at one time was 50,000 head and during a peak working season they employed as many as 150 cowboys. Many of these cowboys later became prominent stockmen and farmers in McCone County.

In 1902 the N-N was sold to the Pioneer Land & Cattle Company. The brand used by this company was the CK after its president, Conrad Kohrs, one of Montana's most prominent early citizens.

The Pioneer Land & Cattle Company operated on a large scale until it closed out in 1915. As many as 45,000 cattle were run by the CK in one season. The CK was one of the last large ranch operators to bring in Longhorn cattle from Mexico, with 7,000 head shipped from there to their ranch in 1911.

One other ranch should be noted in the livestock history of McCone County, the Circle (O) Ranch. The Circle (O) Ranch was established in 1884 by Mayberry and Carter, who continued operations until 1900 when the ranch was sold to Cross and Quigley. Cross and Quigley established a saloon and stopping station at the Circle (O) Ranch, which in later years brought about the location of the town of Circle.

Sheep began appearing on the ranges of McCone County as early as 1898. Some of the first sheepmen in the area were Dan Lavalley and Peter Dreyer, who located in the western part of the county. Probably the largest sheep ranch operation in the area was run by Tom Cotter who ran as many as 20,000 head.

By the year 1915, the operations of big cattle ranches were on the decline; in fact many of them had already sold out. The main reasons why the big cattle outfits closed out at this time were the incoming homesteaders and sheepmen who forced the cattle ranchers out by running sheep on the range, fencing the land and planting crops.

The homesteaders were of every race, religion and class, and all had one basic goal—to get rich as quickly as possible. However, the homesteaders faced many a hardship and if it hadn't been for an occasional stray beef and the abundant supply of lignite coal, many of them would have never survived. The drouth years of 1917 to 1923 forced many homesteaders to relinquish their land which reverted to the county for taxes. Those who stayed survived by hard work and some luck, and eventually made a success of their farm operations.

Today, agriculture is the principal industry of McCone County. The farms are mostly of the dryland type, although there are some diversified farm operators in the central part of the county. The largest percentage of agricultural land is the rangeland for the livestock operations, while the cultivated farm areas produce primarily wheat, oats, barley and alfalfa hay. There is a small amount of irrigation in the county, most of which is located in the northern part along the Missouri River. The livestock raised are mainly cattle and sheep, with some hogs for local consumption.

During the drouth periods (1917-1923) and at a later period (1930-1940), diversified farming came more into prominence along with all phases of soil conservation practices and better farming methods initiated into farm programs.

What could become a new industry in the area is the drilling of oil which so far has been confined to the eastern part of the county.

Over forty miles of Fort Peck Lake borders the western part of McCone County, with numerous recreational sites along its shore line constructed for sportsmen and outdoor enthusiasts. The Fort Peck power dam has made electric power available to rural areas through the R.E.A.

McCone County is a part of the Great Plains Region of the United States that extends into Montana. The elevation of this plains country ranges from 2,000 feet in the eastern part to a height of nearly 4,000 feet in the western foothills of Montana. In McCone County this vast expanse of rolling lands is broken by wide isolated valleys and some isolated hills. The drainage area consists of the headwaters of the Redwater River and its tributaries in the southern and eastern part, where the river flows north and empties into the Missouri River near the McCone-Richland County boundary. Some of the numerous small tributaries to the Redwater River are: Tussler, Horse, Duck, Cow, Wolf, Sheep and Nickwall Creeks, to name a few. Two other streams in the central part of the county that flow north and empty into the Missouri River are Prairie and Sand Creeks. The western part consists of the Big Dry with its tributaries of Timber, Nelson, McCuire, Rock, Bear and Milk River Coulee. Since Fort Peck dam was completed, the Big Dry Creek channel in McCone County is now inundated by backwaters of the Fort Peck Reservoir. The Missouri River forms the northern boundary of McCone County.

McCone County was created on February 19, 1919, from part of Prairie, Richland and Dawson Counties. It was named after Senator George McCone of Dawson County, who exerted considerable influence during the legislative session favoring passage of the bill creating the new county.

The main town in McCone County is Circle, the county seat, with a population of about 1,100 people. It was named after the Circle (O) Ranch, one of the pioneer ranches of the early days located near the townsite. Other small towns and rural communities in the county are: Brockway, population about 200; Presserville, Sand Creek and Vida. Presserville is on State Highway No. 13, with Sand Creek and Vida located west and east of Presserville, respectively, on secondary roads.

Transportation facilities in McCone County are limited to three state highways and several secondary county roads. State Highway 200S begins at Glendive and connects with State Highway 200 at Circle. From Sidney, State Highway 200 passes through Circle to Jordan and west to Lewistown. Beginning at Circle, State Highway 13 follows a course northward connecting U. S. No. 2 at Wolf Point. The nearest airport facilities are at Sidney and Glendive, although many "flying" farmers and ranchers have their own small planes in McCone County.

CLIMATE

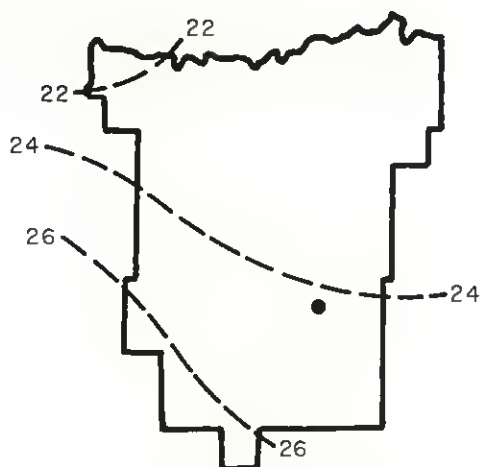
With the Missouri River bordering to the north and plains in other directions, McCone County, like the surrounding counties, is relatively flat. The average elevation is under 3,000 feet.

Being located east of the Continental Divide, the climate can be classified as a Continental type; that is, warm summers, cold winters, and sparse precipitation. However, 50 percent of the precipitation falls during the critical growing season, May through July. Temperature extremes of -57° and 110° have been observed.

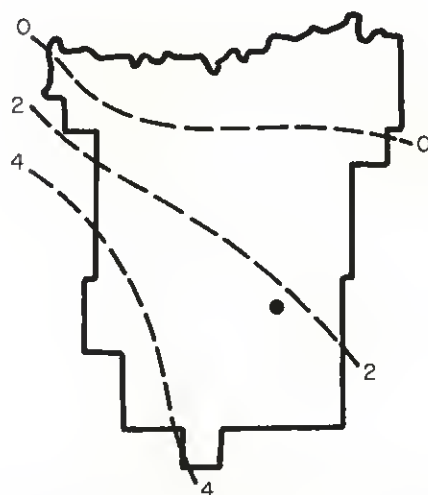
The three most important weather producers during the year are arctic invasions during the winter, an occasional active low pressure during the spring, and thunderstorms during the summer. Without protection of mountain barriers, arctic outbreaks accompanied by strong winds occasionally cause blizzards with considerable drifting snow and below zero weather is common. True chinook conditions occur much less frequently than near the Continental Divide. Snowfall during the year ranges 25-35 inches. During the spring cold rains and snow can prove damaging to livestock.

By summer, precipitation gradually changes into showery nature, with thundershowers occurring about every four days. Occasionally these thundershowers are strong enough to produce damaging winds and hail. Tornadoes, though rare, have been observed.

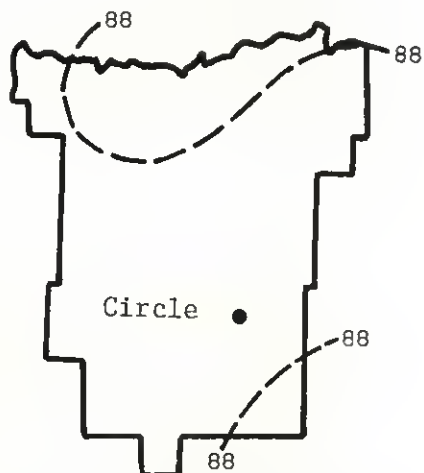
The lower elevation of the County causes a slightly longer growing season than areas of western Montana. The first frost occurs from middle to end of September with the last frost near end of May. However, frosts have been observed during June through August.



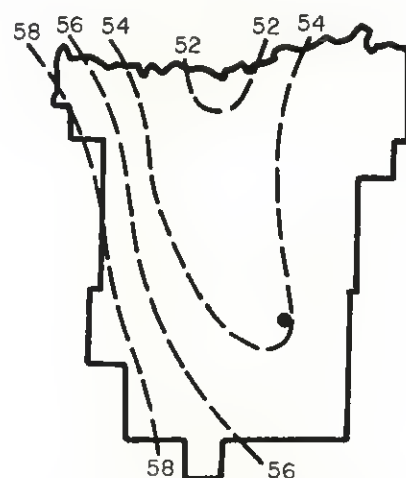
MEAN MAXIMUM TEMPERATURE JANUARY (°F)



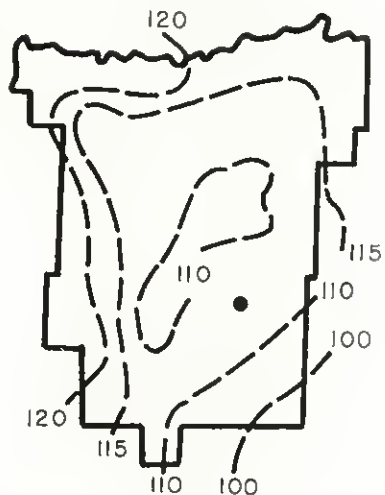
MEAN MINIMUM TEMPERATURE JANUARY (°F)



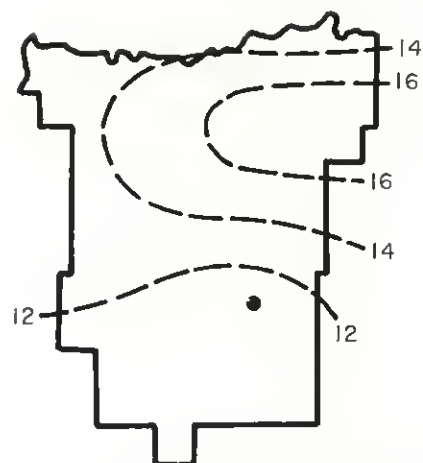
MEAN MAXIMUM TEMPERATURE JULY (°F)



MEAN MINIMUM TEMPERATURE JULY (°F)



MEAN ANNUAL GROWING SEASON IN DAYS



MEAN ANNUAL PRECIPITATION IN INCHES

CLIMATIC DATA — McCONE COUNTY

Isalines are drawn through points of approximately equal value. Caution should be used in interpolating on these maps, particularly in the more hilly areas.

POTENTIAL IRRIGATION DEVELOPMENT

Glenn R. Smith, Soil Scientist

Dave R. Cawfield, Consulting Soil Scientist

INTRODUCTION

The major features that determine the desirability of an area for irrigation development are the type of soil, topography, availability and quality of irrigation water, and the climate and markets. Soils and topography, together with frost free season and mean temperature largely determine the ability of an area to produce, assuming that a dependable water supply is available, and finally a market is necessary to obtain a profit from crops that are produced. **This article is based on a long range projection which disregards the present available water supply for irrigation and market factors of crops produced.**

Land classification is the process by which soils, relief and climate are systematically appraised and lands are placed in categories based on similarity of characteristics. Land classification surveys made by the Montana Water Resources Board are specifically designed to establish the degree of suitability of land for sustained irrigation farming. The objective is to outline the land areas that have a potential for irrigated agriculture. Because technological advances in irrigation are taken into account, slope and surface topography become less important as rapid expansion of sprinkler irrigation takes place.

The land classification system used in the water resources survey separates the land areas into (1) lands having potential for irrigation termed "irrigable" in contrast to (2) the inferior "non-irrigable" lands which are unsuited for present or future irrigation because of unfavorable characteristics. The term "irrigable land" as used in this classification includes land with soils topography and drainage features that are suitable for irrigation by gravity or sprinkler methods. Lands classed as "irrigable" have soil, topography and climate that will support sustained irrigated agriculture with proper water management, drainage and other necessary conservation practices.

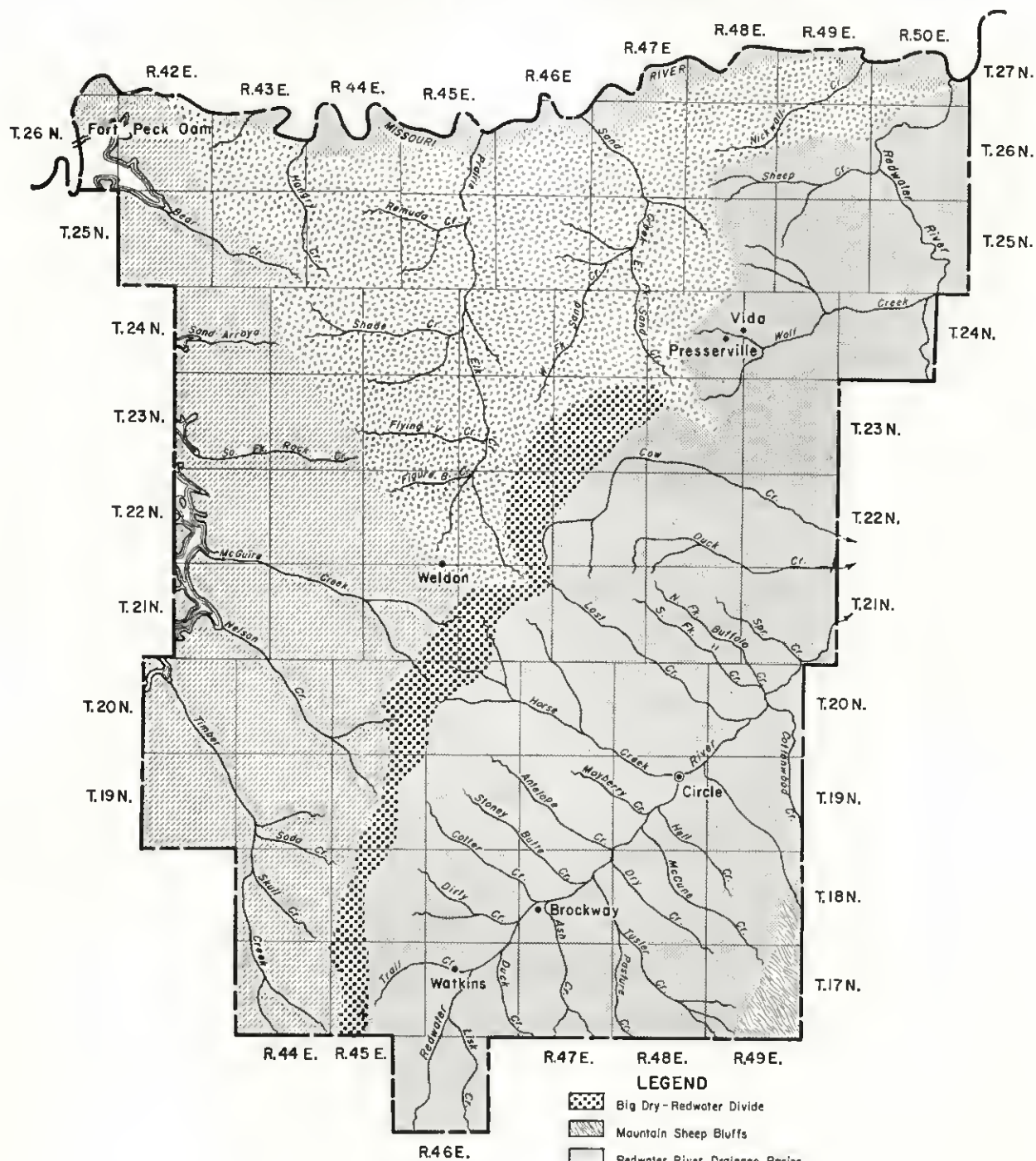
Lands which are classified as "irrigable" are divided into classes on the basis of their relative suitability for irrigation farming. Class 1 represents irrigable land with potentially high productive value; class 2 represents land of intermediate value, and class 3 includes land of the lowest value that may be suitable for irrigation.

The intensity of this land classification is a general reconnaissance survey. **Any future project development should be based on a detailed study** to pinpoint the exact location and limits of the land best suited for irrigation.

PHYSIOGRAPHIC FEATURES AND LAND CLASSIFICATION

McCone County is located south of the Missouri River in east-central Montana. The county covers 2,652 square miles. Fort Peck Reservoir borders the upper two-thirds of the western boundary. The Missouri River borders the northern boundary of the county. These two large bodies of water occupy the majority of the 58 square miles of water surface in the county. For the purpose of evaluating the land and watershed characteristics, the county is divided into five main areas. These are shown on the drainage basin map of McCone County. The physiographic features and soils are described by areas shown on the following map.

McCONE COUNTY—DRAINAGE BASINS



THE BIG DRY CREEK-REDWATER RIVER DIVIDE

The Big Dry Creek-Redwater River Divide is in the central part of the county. The stratified sandstone and shale-capped buttes and ridges extend 5 to 8 miles west of the crest of the divide. The divide is approximately 2,700 feet above sea level. The eastern slopes have a gently sloping topography in parts of the area. Dryland cultivated wheat land is scattered throughout the area. The residual soils of this divide are not generally adaptable to irrigation due to the shallow depths to shale and sandstone substrata. Also the topographic pattern of buttes, small basins and ridges will hinder any water supply delivery. The present land use pattern probably will prevail in this area for some time.

THE MOUNTAIN SHEEP BLUFFS

The divide known as Mountain Sheep Bluffs, between the Missouri and Yellowstone Rivers in east-central Montana, is capped with an ancient stream deposit composed largely of quartzite gravel. This gravel overlies sandstone and siltstone of the Fort Union Formation. In most places the western slope of the divide in the extreme southeastern corner of the county is eroded into a steep, rugged siltstone and sandstone escarpment indented with short, deep coulees. Above the escarpment the divide is eroded into gravel-capped hills, buttes, and tablelands. In McCone County, Mountain Sheep Bluff is a dissected tableland sloping gently to the southeast. The tableland elevation is approximately 3,200 feet and lies 600 to 800 feet above the valley of the Redwater River.

The potential irrigation of any portion of the Mountain Sheep Bluffs area in McCone County is nil. The limiting factors being shallow depths of residual soil over sandstone and siltstone, and the rugged topography. The gently sloping areas are being dryland cropped. The present land use will probably exist for some time.

THE REDWATER RIVER DRAINAGE BASIN

The Redwater River has its source on the Missouri-Yellowstone River Divide in Prairie County. This stream enters the county in the south-central part and flows northeast into Richland County where it turns north again entering McCone County in the southeast corner of Township 24 N., Range 50 E., then flows north into the Missouri River. It has a continuous flow in most seasons and meanders in a valley almost one mile wide. In the southeastern part of the county, its narrow flood plain lies 10 feet or more below high bottom lands. In the northeastern part of the county, the high bottom lands lie 10 to 20 feet above the sandy river wash.

As the Redwater River largely drains a rolling area, its valley slopes are smooth and gentle in most places. The irrigable lands of this basin appear along the main river or its tributaries with very few acres appearing on the upland areas.

The Redwater River Basin From Prairie County Line To Brockway

This section of the basin has approximately 8,000 irrigable acres of which 2,600 acres are class 2 land. Lisk, Duck and Ash Creeks head on the slopes of Mountain Sheep Bluffs, flow north and northwest and empty into the Redwater River. They are all cut-bank intermittent streams flowing through valleys a quarter of a mile wide. The high bottom lands along these streams are not too saline for farming, and many are under dryland cultivation. Dissected gravel-capped ridges occur along the valley of most of these streams. The alluvial soils are generally formed and influenced by

the surrounding parent material, however, some characteristics may be from the parent materials which are a great distance from the alluvial fans. The large areas of irrigable land in the upper Redwater River Basin are the direct result of the surrounding upland areas being gravel-capped ridges and sandstone landforms. The upper drainage areas of Trail, Dirty and Cotter Creeks drain the eastern slopes of the Big Dry Creek-Redwater River Divide. They are intermittent streams of a cut-bank type and meander through the rolling uplands in valleys a quarter of a mile wide. The alluvial bottom lands may be high in salinity depending upon the upland landforms being shale, sandstone or gravel-capped. Trail and Dirty Creeks have areas of irrigable class 2 and 3 lands large enough for consideration of future irrigation. These areas can be associated with a more gently rolling upland area, with sandstone and gravel-capped ridges. The absence of irrigable land along Cotter Creek can be attributed to saline bottom lands, narrow valley and alluvial wash from shale uplands.

The Redwater River Basin From Brockway To The Dawson County Line

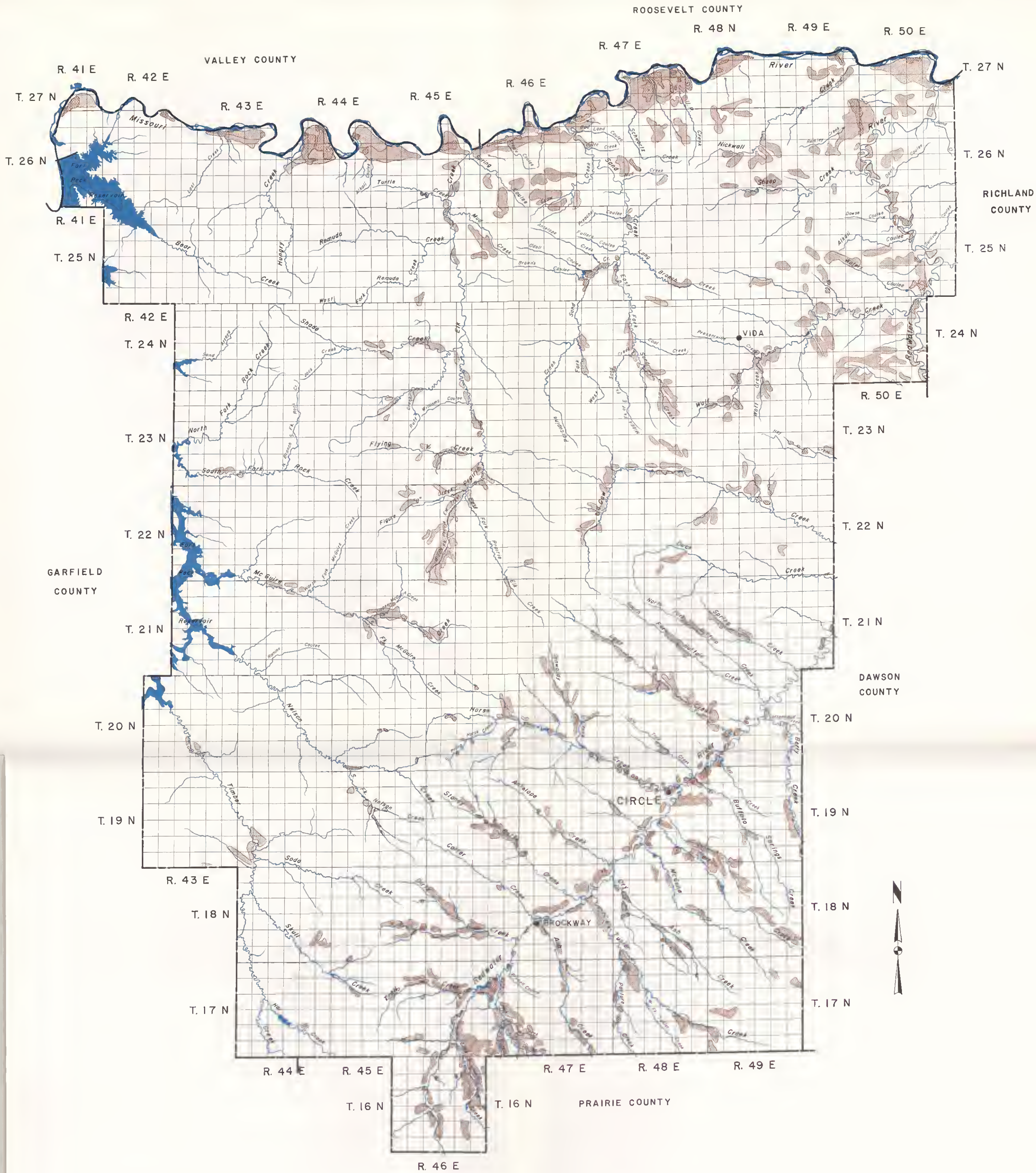
This section of the Redwater River Basin has approximately 12,000 acres of irrigable land of which there are 5,200 acres of class 2 land. The irrigable class 2 land is distributed throughout the alluvial soil area.

The Redwater River Valley is one-fourth to one-half mile wide. The irrigable land is located on first terraces about 10 to 20 feet above the river channel. Occasional flooding of the valley may occur. The soils of the irrigable lands range from heavy to light texture. The salinity is a problem in large portions of the area. If a full water supply were available for irrigation the total soluble salts, particularly the exchangeable sodium, would cause alkaline-saline problems in many spots of the area. The main corrective factor for avoiding alkali and saline soil would be drainage. Detail drainage studies should be made prior to a detailed engineering and land classification study.

The tributary streams that have significant irrigable land areas are the lower valleys of Tusler and Hell Creeks; the upper valleys of Stony Butte and Horse Creeks; and the lower valley of Lost Creek.

Tusler, McCune, Hell and Gyp Creeks are small intermittent cut-bank streams flowing through narrow valleys in the rolling uplands. They head on the western slopes of Mountain Sheep Bluffs, flow northwest, and unite with the Redwater River north of Lisk, Duck and Ash Creeks. Their bottom lands are poorly drained and saline in most places of the upper valleys. The lower valleys of Tusler and Hell Creeks have alluvial bottom lands which are irrigable. The limiting factor for the potential of irrigation is the drainage characteristics. The poor drainage characteristics are evident in the non-irrigable areas, however, this may not be true in the irrigable areas.

Stony Butte, Horse and Lost Creeks rise on the Big Dry Creek-Redwater River Divide, flow southeast, and enter the Redwater River from the west in the southeastern party of the county. They are all intermittent streams of a cut-bank type and meander in the rolling uplands in valleys a quarter of a mile wide. The high bottom lands are saline for some distance above their mouths. The upper valleys near the crest of the Big Dry Creek-Redwater River Divide have significant irrigable land acreages. The main favorable characteristic of the soil forming process is that the alluvium is associated with the sandstone and gravel parent material.



MONTANA WATER RESOURCES BOARD

POTENTIAL IRRIGATION DEVELOPMENT
Reconnaissance Land Classification
McCON COUNTY
 COMPILED FROM DATA AVAILABLE AS OF JULY 1971

Compiled from U.S. Bureau of Reclamation & Soil Conservation Service Data, Aerial Photographs, U.S. Government Land Office Surveys & Field Investigations

Soil Scientists: Glenn Smith & Dave Cowfield
 Drafted by: June Vreag, Robert Ebert, James Sharkey

Scale
 0 2 4 6 8 Miles

| EXPLANATION | |
|--|--------------------------|
| | IRRIGABLE LAND CLASS 1 |
| | IRRIGABLE LAND CLASS 2 |
| | IRRIGABLE LAND CLASS 3 |
| | PRESENTLY IRRIGATED LAND |
| <small>Note: IRRIGABLE AREAS ARE MAPPED REGARDLESS OF AVAILABLE WATER SUPPLY.</small> | |
| <small>Definition: IRRIGABLE LAND - LANDS CAPABLE OF BEING IRRIGATED BY GRAVITY OR SPRINKLER METHODS OF WATER APPLICATION.</small> | |

The Lower Redwater River Basin

The Redwater River runs into Dawson County and re-enters McCone County at the southeast corner of Township 24 N., Range 50 E., then flows north approximately 25 miles where it empties into the Missouri River. Cow and Duck Creeks head in east-central McCone County and flow in easterly directions into the Redwater River in Richland County. Duck Creek has very little irrigable land along its course. Cow Creek has its source in a water gap on the Big Dry Creek-Redwater River Divide in the central part of the county. This stream is one of the largest in the northeastern part of the county and drains a rolling area. It has continuous flow until late season. The lower valley of this stream averages one-half mile wide. Much of the lower part of the valley is poorly drained and saline. The upper portion of the valley has irrigable areas that are large enough for irrigable land delineations. There are approximately 3,700 irrigable acres in the upper Cow Creek Drainage of which 500 acres are class 2 land.

The Redwater River re-enters McCone County and flows through the glaciated plains until it empties into the Missouri River.

The glaciated plains of northern Montana extend south into the northern part of McCone County. One of the later continental ice sheets deposited a mantle of till over the area. In the northeastern part of the county, glaciation altered stream channels and glacial duff filled the preglacial channels. Poorly drained dry glacial lake basins are a part of the glacial terrain.

The gently sloping uplands and the Redwater Valley are not adaptable for large bodies of irrigable land. The lower Redwater watershed does have approximately 15,000 acres of irrigable land which is dispersed throughout the general area. The soils are of medium textured glacial origin with medium to heavy textured alluvial valley lands. An estimated one-third of the irrigable acreage is within the Redwater Valley.

THE MISSOURI RIVER VALLEY BOTTOM LANDS

The Missouri River Valley has eroded to a depth of about 200 feet below the floor of the preglacial valley. The physiography of the area is almost entirely a product of glaciation. Blanketing the area north of the Missouri River are deposits of ground moraine and other related deposits of glacial origin. Buried terrace gravels and stream channels are common throughout the valley in McCone County. Soils have been derived primarily from glacial materials, although recent alluvial soils are found in places.

The topography is characterized by extended meanders and wide terraced flood plains of the Missouri River. To the south, badlands topography is prominent; the river breaks are abrupt and about 200 feet above the valley floor. The predominating formation is till covered, shale badlands.

The bottom land terraces are the only large sized land areas that can be considered irrigable. The soils are composed of recent alluvium deposited on the present flood plain of the Missouri River. The soil textures of the irrigable land vary from loamy sands to clays, but are predominantly composed of porous, well-drained, medium-textured material. The principal differences of these youthful soils are a result of differences in both parent material and depositional stratification. Clay fractions of the alluvial soil profile are generally composed of calcic clay. Although infiltration rates are reduced rapidly as the clay is wetted and swells, field tests show the water movement stabilizes at

a sufficient rate to assure continuous leaching. These alluvial soils are capable of producing high yields of all crops adapted to the climatic conditions of the area.

The badland and rolling topography to the south of the river valley has eroded severely during geologic times. Small tributary streams have cut through the river breaks and uplands. Recent material from the erosive process has washed over the floodland terraces, especially near the river breaks where the colluvial soils have developed from very diverse parent materials. The soils are developed principally from sandstone and shale and consist of medium to coarse textured material extending to depths of 10 to 40 feet. The erosion of the shale badland will cause a high sodium, fine textured soil which is highly saline and unsuited for diversified irrigation farming.

The topography of the irrigable lands are generally favorable for irrigation development. Gradients of most of the land range from about 0.5 to 2.0 percent, and surface undulations are such that light to medium land leveling would be sufficient for irrigation.

The surface relief of the recent alluvial terraces is undulating with overflow banks and channels occurring near the river. Interspersed swale like remnants of old channels extend outward from the river to join valley slopes or intermediate alluvial terraces. The intermediate terraces have smooth, very gentle slopes. Colluvial slopes often lie in one gentle plane, but complex slopes exist where small tributaries enter the valley.

The Bureau of Reclamation made extensive drainage investigations of the Missouri Valley bottom lands. The intensity of these surveys are considered adequate for delineation of lands suitable for irrigation development. At such future times as any units may be studied in detail as a basis for possible construction, more intensive drainage investigations may be required to confirm results of these reconnaissance studies.

Natural surface drainage is generally good throughout the river bottom lands. The gradients are favorable for removal of surface water with only minor construction of artificial drains. However, evaluations of the drainability of subsurface soils showed that with sustained irrigation, subsurface drains would be required on all units.

The recent alluvial terraces are underlain with sand or gravel, or both. The material underlying the colluvial soil on valley slopes varies widely in texture and chemical characteristics, and only those soils that could be drained within practical limits are included in the irrigable lands.

The use of sprinkler irrigation on some of the units should decrease the quantity of subsurface water which in turn will lower the drainage costs. The soils of this area should be studied for sprinkler use. Heavy textured areas may not be adaptable, whereas the very light textured areas near the river could be considered irrigable if sprinkler irrigation is applied.

There are 17,000 irrigable acres in the Missouri Valley of which 11,100 acres are considered under project plans. The present 4,500 acres of private irrigation (acreage taken from 1971 Water Resources Survey) could be considered for project full water supply. The individual projects under this plan are:

| ¹ Unit | Location | Total Irrigable Plus Present Irrigated Acres |
|-------------------|--|---|
| Farmer Creek | Above the mouth of Hungry Creek in T. 26 N., R. 43 E. | 900 |
| N-Bar-N | 18 miles east of Fort Peck Dam and 18 miles west of Wolf Point | 3,200 |
| Wapiti Unit | Flood plain terraces near the mouth of Prairie Elk Creek to a point 3 miles northeast of the mouth of Sand Creek | 3,700 |
| Fort Charles Unit | Flood plain terrace 1 mile southwest of the mouth of Spring Creek to Highway 13 Missouri River Bridge | 3,200 |
| Bridge Unit | Small flood plain terrace 1 mile downstream from Highway 13 Missouri River Bridge | 400 |
| Nickwall Unit | Flood plain terrace from Sec. 19, T. 27 N., R. 50 E., to the mouth of the Redwater River | 2,300 |
| | | <hr/> Total 13,700 |

¹Report on Northeast Montana Division, Missouri River Basin Project, Bureau of Reclamation, Great Falls, Montana, March 1969 (Revised September 1969).

Comprehensive irrigation development of the Missouri Valley area would permit greater crop diversification and better utilization of irrigable land. Sustained irrigation would allow increased hay production, corn production for silage and higher feed grain growth, which adds up to additional concentrated feeding of livestock. The cash crops production would allow sugar beets, potatoes and alfalfa hay, increasing cash value which would stabilize and intensify agricultural production.

SMALL STREAMS AND BREAKLANDS OF THE MISSOURI RIVER

The breaklands of the Missouri River are rough broken lands which are Bearpaw shale formations at the lower levels. The higher breaklands further south of the river consist of broken sandstone ridges separated by deep narrow intervening stream valleys. The ridges lie 300 to 400 feet above the level of the river, and the slopes are covered with sandstone slabs and erratic boulders.

East of Prairie Elk Creek the slopes of the Missouri Valley are covered with till, and only locally, such as north of Nickwall Creek, does sandstone form bluffs along the valley.

Prairie Elk Creek has its source in a water gap in the Big Dry Creek-Redwater River Divide in the central part of the county, flows almost due north, and empties into the Missouri River in Section 13, Township 26 N., Range 45 E. This stream meanders in a valley almost a mile wide and has a continuous flow in most years. The creek heads by three small tributaries flowing together in Section 6, Township 22 N., Range 46 E. The valleys of the tributaries are about $\frac{3}{4}$ mile wide and of smooth, very gently sloping topography. The rough breaklands are high sandstone escarpments capped by sandstone rocks which are 300 to 400 feet above the valley floor. The alluvial terraces are high bottom lands above the poorly drained floodplain of the streams. The soils are formed from the nearby sandstone parent material. Erosion of the sharply sloping sandstone ridges adds alluvium to the area continually.

The majority of the irrigable land within the Prairie Elk Creek watershed is alluvial soil in the upper drainage basin, which is generally light textured and free of saline salts. However, there are numerous areas of high saline soil in portions of the area. The present land use of these soils is rangeland with dryland farming of the broad alluvial land areas.

The lower Prairie Elk Drainage Basin is in the Bearpaw shale area which borders the Missouri River. There is very little irrigable land within the stream valley. The alluvial soils formed from shale parent material are high in exchangeable sodium, and also in saline salts.

There are 6,500 acres of irrigable land of which 3,000 acres are class 2 land within the Prairie Elk Creek watershed. The majority of the land is in the stream valleys of the upper watershed.

Sand Creek heads on the Big Dry Creek-Redwater River Divide in the central portion of the county and flows north to join the Missouri River southwest of Wolf Point. It is an intermittent stream flowing through a small valley bordered by sharply rolling uplands. The alluvial bottom land terraces are similar to the irrigable alluvial bottom lands of Prairie Elk Creek. There are approximately 2,500 irrigable acres in the narrow stream valleys of the Sand Creek watershed.

Nickwall Creek is an intermittent stream, heading on a till-covered divide east of Sand Creek and flows northeast into the Missouri River a few miles west of the mouth of the Redwater River. The upper course of this stream is a small valley entrenched in glaciated uplands, but its lower course is through a wide basin covered with heavy alluvial material. The alluvial soils are heavy to medium textured, being formed from the medium textured till uplands. There are approximately 2,400 irrigable acres along Nickwall Creek, however, a large portion of the land may be on the till uplands bordering the stream valley.

BIG DRY CREEK BASIN

Big Dry Creek rises on a high divide in the southwestern part of Garfield County. This stream meanders along the county line in the west-central part and empties into the Missouri River south of Fort Peck Dam in Garfield County. Big Dry Creek was a small perennial stream flowing through a broad valley bordered by rough broken land before its lower valley was inundated by the water of the Fort Peck Storage Reservoir.

The tributaries that drain into the Big Dry Creek Arm of Fort Peck Reservoir are Timber, Nelson, McGuire and South and North Forks of Rock Creek. The creeks head on the Big Dry Creek-Redwater River Divide and flow northwest or west into the reservoir. The drainage basin of Big Dry Creek in McCone County is rough broken lands to sharply rolling lands. The geomorphologic characteristics of these landforms are highly rounded hills and ridges which give way to rough breaks. The breaks are 75 to 150 feet above the level of the streams and in places are separated by wide basins such as that drained by Sand Arroya. The geologic formations are stratified sandstones and shale-capped buttes and ridges on the upper divides. The lower areas are of the Fort Union formation which is composed of shale and seams of lignite coal. The rough breaks formations are Tullock and Hell Creek shales with interbedded sandstone.

The only areas of topographic characteristics favorable for irrigation are the narrow alluvial stream valley lands. The soil forming process of these alluvial valleys is erosion from the nearby breaks and steep rolling uplands. The erosion of the predominantly shale formations has deposited

a highly saline, sodium alluvium into the stream valleys. The soils formed from this alluvium are heavy textured, highly saline and unfit for any consideration of irrigation. There are local exceptions to this only where the alluvium was from a sandstone formation. Small areas of irrigable land do appear on the upper valleys of Timber and McGuire Creeks. The broad nature of a reconnaissance survey does not allow for laboratory analysis and if tested the soil may have too high a salinity content for irrigation.

PRESENTLY IRRIGATED LANDS

The present irrigation in McCone County can be divided into two categories; first, the Missouri River Valley bottom lands; and second, the remaining irrigated lands of all the Missouri River tributaries in McCone County. These two divisions are necessary because of water supply for present irrigation and the proposed expansion of irrigation.

The Missouri River Valley bottom lands have a full water supply for irrigation by pumping directly from the Missouri River. The cropping of this area can be intensified with silage corn, alfalfa, and small grains yielding as expected for irrigated land.

The Missouri tributary streams in McCone County are mostly intermittent, with the Redwater River, Prairie Elk Creek and Cow Creek being perennial small streams. Therefore, the irrigation is also intermittent with the main water supply being from spring run-off. Small storage dams are scattered throughout the watersheds, many for irrigating hay crops. The irrigation systems are generally dikes with controlled gates. The water is held behind a dike until the ground is saturated then the gate is raised and the water runs into the next dike. The hay yields are generally improved from one-half ton per acre to one and one-half tons. The spreader type irrigation is adding many tons of feed base for the ranchers. However, if irrigation was under a full water supply a much higher yield could be expected, but the problems will multiply with drainage, salinity and weeds. The net returns from irrigation should increase enough to offset the additional costs and problems. If water from Fort Peck is ever pumped into the county the presently irrigated lands should be closely evaluated, and if irrigable, should be considered for full supply irrigation.

If water is not brought in from other sources the future of any irrigation expansion other than the Missouri Valley bottom lands is very limited. Careful examination of the small stream watersheds is necessary as some water supplies are becoming nearly exhausted.

DRAINAGE

²Drainage in agriculture is the process of removal of excess water from the soil. Excess water discharged by flow over the soil is referred to as surface drainage, and the flow through the soil is termed internal or subsurface drainage. The terms "artificial drainage" and "natural drainage" indicate whether or not man has changed or influenced the drainage process.

Natural drainage is the basic system now in McCone County, a few exceptions exist on the small irrigated areas. If full water supply irrigation systems are ever available, the drainage of the

²Diagnosis and Improvement of Saline and Alkali Soils, United States Salinity Laboratory Staff, Agricultural Handbook No. 60, United States Department of Agriculture, 1953.

stream valleys should change to an artificial drainage system. The irrigable lands are located within the narrow stream valleys and the drainage within many areas of these valleys is questionable. The general reconnaissance land classification survey considers the upper five feet of soil from the morphological soil characteristics. The drainage characteristics are also assumed from morphological soil characteristics. This type of an evaluation may be adequate for general studies, however, whenever a detailed study is made, deep borings and soil sample analysis is necessary to properly evaluate the drainage.

In McCone County a drainage investigation should be conducted before the lands are considered irrigable beyond the reconnaissance survey level. The investigation should include information regarding the occurrence, flow and disposition of excess water within a given basin or area. Further information is needed in regards to hydrology, geology, meteorology, topography and soils.

²Whenever a project of any size is planned for development, a drainage program for irrigated land should be initiated and continuously integrated with the development of the irrigation system in order to attain an efficient over-all water and salinity control program.

SUMMARY

The reconnaissance land classification of McCone County tabulations are approximately 87,300 irrigable acres; 200 irrigable acres of class 1 land; 23,100 irrigable acres of class 2 land; and 64,000 irrigable acres of class 3 land. The reconnaissance land classification does not attempt to separate the type of irrigation as to sprinkler or gravity. Considering the general nature of a reconnaissance study it is possible that detail studies will show either an increase or decrease in the irrigable areas by as much as 10 to 30 percent in some areas.

It is anticipated that the expansion of irrigated agriculture in McCone County will be developed first on the Missouri River Valley bottom lands. Every effort should be made to acquire early development of these irrigable lands on a project basis. The present limited development by private investments have accounted for 4,500 acres of irrigation. However, the private developments are not resulting in optimum development and productivity of the land.

There are 5,600 acres of presently irrigated land outside of the Missouri Valley bottom lands. The hay and pasture production from these lands are limited due to the inadequate water supplies. The future of expanding irrigated acreage is limited to importation of water from other than the present small streams. This would be very costly, and probable only if irrigated agriculture and industry could share the costs of water. Industrial use of water for producing power and other resources from large coal deposits in McCone County is possible.

Any future irrigation project development should include a drainage investigation. The salinity problem of principal economic importance arises when previously non-saline soil becomes saline as the result of irrigation. Narrow stream valleys are very susceptible to this, and farmers frequently fail to recognize the need for establishing artificial drains to care for the additional water and soluble salts. The drainage survey before irrigation will establish the costs of minimizing seepage and salinization of the soil. There are many acres of the irrigable land within McCone Coun-

²Diagnosis and Improvement of Saline and Alkali Soils, United States Salinity Laboratory Staff, Agriculture Handbook No. 60, United States Department of Agriculture, 1953.

ty that the costs of drainage will be prohibitive for irrigation. However, it should be remembered that whenever soil becomes seeped and strongly alkaline or saline to the point where crop production is curtailed, it generally is a permanent waste of cropland.

The irrigable land acreage will change as areas are studied with detailed drainage and land classification surveys. The drainage investigations will establish the cost of minimizing seepage and salinization of the soil. The detailed land classification investigations will establish the land areas that will sustain irrigated agriculture and give an economic standard for evaluating repayment of irrigation costs to the sponsoring agency.

Any expansion of irrigation on acreages large enough for project development will greatly increase the economy of McCone County. The main emphasis will probably be an addition to the livestock industry. The costs of expanding irrigation may not be feasible at this time. However, discouragement should not persist because irrigable areas could be feasible within the near future especially when the acreages necessary for food and fiber needs show additional planning necessary for production, projecting into the years 1980, 2000 and 2020. This expansion will warrant development in areas that are not presently feasible.

The local, federal and state agricultural agencies have soil surveys and experimental information available that help determine areas for future irrigation and management of presently irrigated land within McCone County. Contacting these agencies will save individual farmers money and labor, and will also assist in conserving land for future use.

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²Diagnosis and Improvement of Saline and Alkali Soils, United States Salinity Laboratory Staff, Agriculture Handbook No. 60, United States Department of Agriculture, 1953.

STREAM GAGING STATIONS

The U. S. Geological Survey measures the flow of streams, cooperating with funds supplied by several state and federal agencies. The results have been published yearly in book form by drainage basins in Water-Supply Papers through the year 1960. Beginning with 1961, the streamflow records have been published annually by the U. S. Geological Survey for the entire state under the title, "Surface Water Records of Montana". Data for 1961-65 and subsequent five-year periods will be published in Water-Supply Papers. Prior to general issuance, advance copies of station records may be obtained from the U. S. Geological Survey. That agency's records and reports have been used in the preparation of this resume'.

Data given below cover the stream gaging records, which are available for McCone County from the beginning of measurements through the water year 1970. The water year begins October 1 and ends September 30 of the following year.

Following are equivalents useful in converting from one unit of measurement to another:

- (a) In Montana, one cubic foot per second equals 40 miner's inches.
- (b) One acre-foot is the amount of water required to cover an acre one foot deep.
- (c) One cubic foot per second will nearly equal two acre-feet (1.983) in 24 hours.
- (d) A flow of 100 miner's inches will equal five acre-feet in 24 hours.
- (e) One miner's inch flowing continuously for 30 days will cover one acre 1½ feet deep.

For reference purposes, the stream gaging stations are listed in downstream order.

Missouri River below Fort Peck Dam* (Valley County)

The water-stage recorder is about 2 miles upstream from Milk River, 6 miles south of Nashau, and 8 miles downstream from Fort Peck Dam. The drainage area is 57,556 square miles. Records are available from March 1934 to date (1970). The maximum discharge was 51,000 c.f.s. which includes 32,000 c.f.s. inflow from a spillway located 1 mile downstream from the station (August 8, 1946) and the minimum, maximum daily reverse flow of 400 c.f.s. caused by backwater from the Milk River (March 29, 1943). The average discharge for 5 years (1934-39, prior to Fort Peck Reservoir reaching operational level) was 6,347 c.f.s. or 4,598,000 acre-feet per year; 26 years (1943-69, after operational level in Fort Peck Reservoir was reached), 9,292 c.f.s. or 6,732,000 acre-feet per year. The highest annual runoff was 10,320,000 acre-feet (1955) and the lowest, 2,642,000 acre-feet (1942). Flow is completely regulated by Fort Peck Reservoir. There are diversions for irrigation of about 879,700 acres above the station.

Missouri River near Wolf Point* (Roosevelt County)

The water-stage recorder is 500 feet downstream from the bridge on State Highway 13, 5 miles southeast of Wolf Point, 7.8 miles downstream from Wolf Creek, and at mile 1,701.4. The drainage area is 82,290 square miles. Records are available from September 1928 to date (1970). The max-

imum discharge was 66,800 c.f.s. (March 25, 1939) and the minimum daily discharge, 320 c.f.s. (December 10, 1941). The average discharge for 11 years (1928-39, prior to Fort Peck reaching operational level), 7,219 c.f.s. or 5,230,000 acre-feet per year; 26 years (1943-69, after operational level was reached), 9,991 c.f.s. or 7,238,000 acre-feet per year. The highest annual runoff was 11,470,000 acre-feet (1955) and the lowest, 2,970,000 acre-feet (1942). The flow is partly regulated by Fort Peck Reservoir and many other reservoirs above the station. There are diversions for irrigation of about 1,009,700 acres above the station.

Redwater River at Circle*

The water-stage recorder and sharp-crested weir are 1 mile upstream from Horse Creek and at mile 79.6. The drainage area is 547 square miles. Records are available from April to November 1929, March to November 1930, July 1931 to December 1932, March to June 1933, February to November 1934, April 1935 to December 1936, and April 1937 to date (1970). The maximum discharge was 6,730 c.f.s. (July 14, 1957) and the minimum, no flow at times in most years. The average discharge for 34 years (1931-32, 1935-36, 1937-69) was 14.5 c.f.s. or 10,510 acre-feet per year. The highest annual runoff was 44,730 acre-feet (1952) and the lowest, 27 acre-feet (1941). There are a few minor diversions for irrigation of hay meadows above the station.

Partial Record Stations and Miscellaneous Discharge Measurements

In order to provide information on more streams than are covered by stream gaging stations, the U. S. Geological Survey has for several years been collecting some partial records. These are in addition to the miscellaneous discharge measurements which have always been reported. These partial records, when correlated with simultaneous discharges of nearby continuous-record stations give fair indications of available flow.

There are eleven crest-stage partial-record stations in the Missouri River Basin in McCone County. Stations are now (1970) being operated on East Fork Duck Creek near Brockway, Duck Creek near Brockway, Redwater River at Brockway, Tusler Creek near Brockway, Tusler Creek tributary near Brockway, Redwater River tributary near Brockway, South Fork Dry Ash Creek near Circle, McCune Creek near Circle, Cow Creek tributary near Vida, Wolf Creek tributary near Vida, and East Fork Sand Creek near Vida.

The partial-record stations as well as the miscellaneous discharge measurements are listed at the end of each U. S. Geological Survey Water-Supply Paper or Surface Water Records report.

RESERVOIRS

Details of operation records for the following reservoir are available in U. S. Geological Survey publications.

Fort Peck Reservoir at Fort Peck* (Garfield and Valley Counties)

The water-stage recorder is located in the No. 4 emergency gate shaft of Fort Peck Dam, 2 miles downstream from Bear Creek, 9½ miles southwest of Nashua, 9½ miles upstream from Milk River, and at mile 1,771.6. The drainage area is 57,500 square miles. Records are available from October 1937 to date (1970). The maximum contents was 18,480,000 acre-feet (July 14, 1970) and

the minimum since first filling, 5,061,000 acre-feet (January 25, 26, 1956). Storage began in 1937. The total capacity is 19,140,000 acre-feet below elevation 2,250 feet (top of 25-foot gates). Normal maximum operating level is 18,170,000 acre-feet (elevation, 2,246 feet). Minimum operating level for on-site power generation is 4,346,000 acre-feet (elevation, 2,160 feet). Dead storage is 563,900 acre-feet below elevation 2,095 feet. Water is used for navigation, recreation, flood control, and power generation.

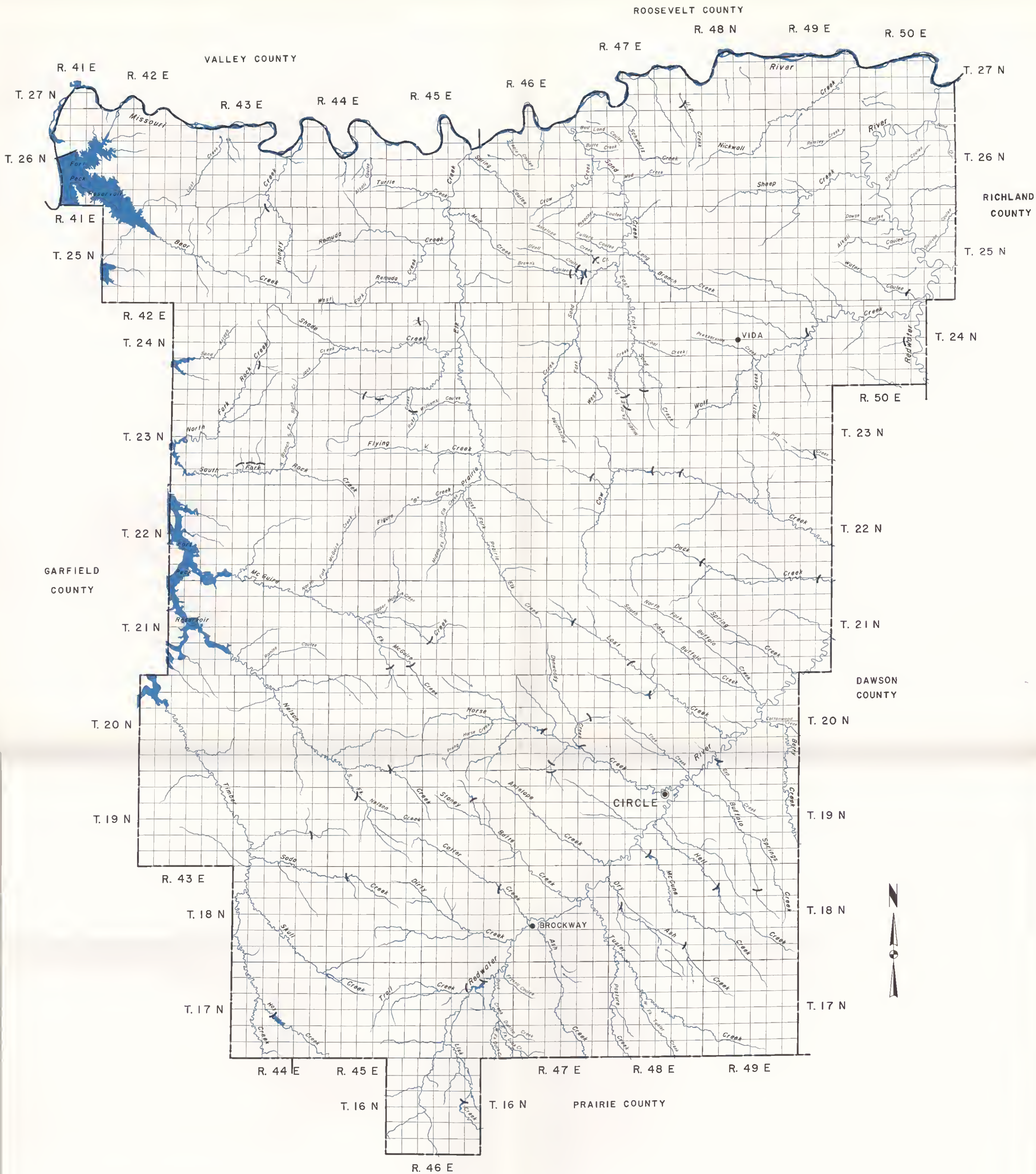
*This station is now in operation (1970).

DAMS AND RESERVOIRS

The State of Montana has no statutes governing the design or construction of dams and, except for projects which the Montana Water Resources Board has constructed, the Board has no means of automatically obtaining information concerning design specifications, storage capacities, locations, or ownerships of dams and reservoirs built throughout the State. Consequently, steps have been taken to make this information available for use by the State, Federal Government, and private citizens.

By means of a questionnaire, the Montana Water Resources Board recently obtained from the various federal agencies who design structures, the basic engineering data, locations, and ownerships of dams and reservoirs for which they either have, or had, responsibility and which have storage capacities of 50 acre-feet or more. The contributing federal agencies were the Soil Conservation Service, the Forest Service, the Bureau of Reclamation, and the Bureau of Land Management. The Montana Power Company also participated in the study.

Information on numerous dams and reservoirs constructed by private individuals in Montana is not available and is, therefore, omitted. However, the Board's Water Resources Survey crew, while working in McCone County, obtained information on private dams and reservoirs within this county. The available information obtained from all sources was compiled by the Board for each county in the State and a list of dams and reservoirs which store 50 acre-feet or more of water was published.



MONTANA WATER RESOURCES BOARD

REGISTRY OF DAMS LOCATION MAP

McCONE COUNTY

COMPILED FROM DATA AVAILABLE AS OF JULY 1971

Compiled with the assistance and cooperation of the Dept. of Agriculture, Soil Conservation Service, Forest Service, Dept. of Interior, Bureau of Land Management, Bureau of Reclamation, Montana Power Co. & U.S. Army Engineers by the Water Resources Survey.

Drafted by June Virag & James Sharkey

Scale
0 1 2 Miles
0 1 2 Kilometers

LEGEND

— Dams 50 acre feet or more

CROPS AND LIVESTOCK

McCone County is located on the eastern edge of Montana. It is bounded on the west by Garfield County, on the north by Valley County and Roosevelt County, on the east by Richland County and Dawson County, and on the south by Prairie County. The western edge of the county is primarily grazing land, and considerable amounts of Burlington Northern and Federal land lie in this area. The main wheat producing areas of the county are in the northeast and southwest corners of the county. A portion of Fort Peck Lake lies in the northwest corner of the county. The northern boundary of McCone County is formed by the Missouri River which is the only perennial stream in the county.

The county contains approximately 1,660,160 acres of which 246,466 acres are federal lands. The economy of the area is mainly agricultural with 542 farms comprising approximately 490,211 acres of farm land.¹ About 8 percent of the farm operators lease all their crop land. The remaining units are a combination of lease and ownership. The county had a 1970 wheat allotment of 126,536 acres, and the county has 2,515 acres classed as irrigated land, 907,596 acres classed as grazing land, and 7,212 acres classed as wild hay.²

A study is presently underway to determine if it would be feasible to irrigate about 98,000 acres in the area, and the county's abundant coal reserves may make this project a reality. If this would occur, the crop production in McCone County would take a dramatic change. The elevation of McCone County ranges from a low of about 1,960 feet along the Missouri River in the northeast corner of the county to a high of somewhat over 3,000 feet. This point is on Antelope Mountain in the southeast corner of the county, and whose peak, 3,467 feet, is in Dawson County.

LIVESTOCK ON FARMS 1970 FROM THE McCONE COUNTY ASSESSOR'S OFFICE

| Cows | Sheep | Hogs | Mink |
|--------|--------|------|------|
| 34,207 | 20,335 | 480 | 450 |

From the Montana Agricultural Statistics, volume 13, Dec. 1970.

CROP PRODUCTION—1969 HARVESTED ACRES

| Crop | Irrigated | | Non-Irrigated | | Total | |
|-------------------------|-----------|---------|---------------|---------|-------|-------------|
| | Acres | Yield/A | Acres | Yield/A | Acres | Value |
| Winter Wheat | | | 66,500 | 32.9 | | \$2,458,100 |
| Durum Wheat | | | 6,000 | 36.4 | | \$ 277,200 |
| Other Spring Wheat..... | | | 69,000 | 27.6 | | \$2,459,100 |
| Oats | | | 12,000 | 55 | | \$ 331,200 |
| Alfalfa Hay | 2,400 | 2.08 T | 6,100 | 1.23 T | | |
| Barley | 300 | 51.7 | 41,700 | 41.5 | | \$1,160,300 |
| Wild Hay | 200 | 1 T | 7,200 | .88 T | | |
| All Hay | | | | | | \$1,015,500 |

¹A farm is defined as all the land under control of one individual, corporation or the like. This number is fewer than the number of operators as listed by the ASCS because although he may be the same individual, he may be considered an operator of several different units, and would be considered an operator for each unit. Therefore, he would be counted more than once.

²The classification of acres comes from the McCone County Assessor's office.

GROUNDWATER

Jim Halloran, Geologist

The Tertiary Fort Union formation makes up the surface of most of McCone County. Below the Fort Union lies the Hell Creek and Fox Hills formations, which are exposed along the Missouri River in the county. There are two gravel formations overlying the Fort Union; on some hills in the southeastern part of the county rests the Flaxville gravel, and in the valleys of the Missouri River and smaller streams are stream gravels.

The geological structure of McCone County is simple. The county is located over the western flank of the Williston Basin. All the formations dip gently southeastward under the county. Any one formation under the northwestern corner will be about 1,250 feet lower under the southeastern corner. Perhaps the most important structural feature is the Weldon fault. (See structural geology map, Figure 1.)

GEOLOGIC HISTORY

From very early geologic time, eastern Montana has been the scene of marine deposition. In this area are limestone formations several thousand feet thick, as evidence of long periods of submarine accretion of sediments. The thick beds of salt are intermittently found in this limestone sequence. This sedimentary sequence was interrupted several times by periods of erosion. During the 150 million years between the end of the thick limestone sequence and the first uplift of the Rocky Mountains, the Williston Basin became the site of both marine and continental deposition. The marine formations are gray and green shales, many thin limestones and several sandstones. The continental beds are generally red or maroon sandstone, siltstones and shales. After the Rockies were uplifted, the shallow seas slowly drained to the east and the basin then became buried by eroded debris from the mountains. Formations such as the Fort Union, Flaxville and recent alluvium have been eroded from the mountains and deposited in eastern Montana. The Fort Union consists of clays, silts, sands and coal. The Flaxville and alluvium are typically gravel and sand formations.

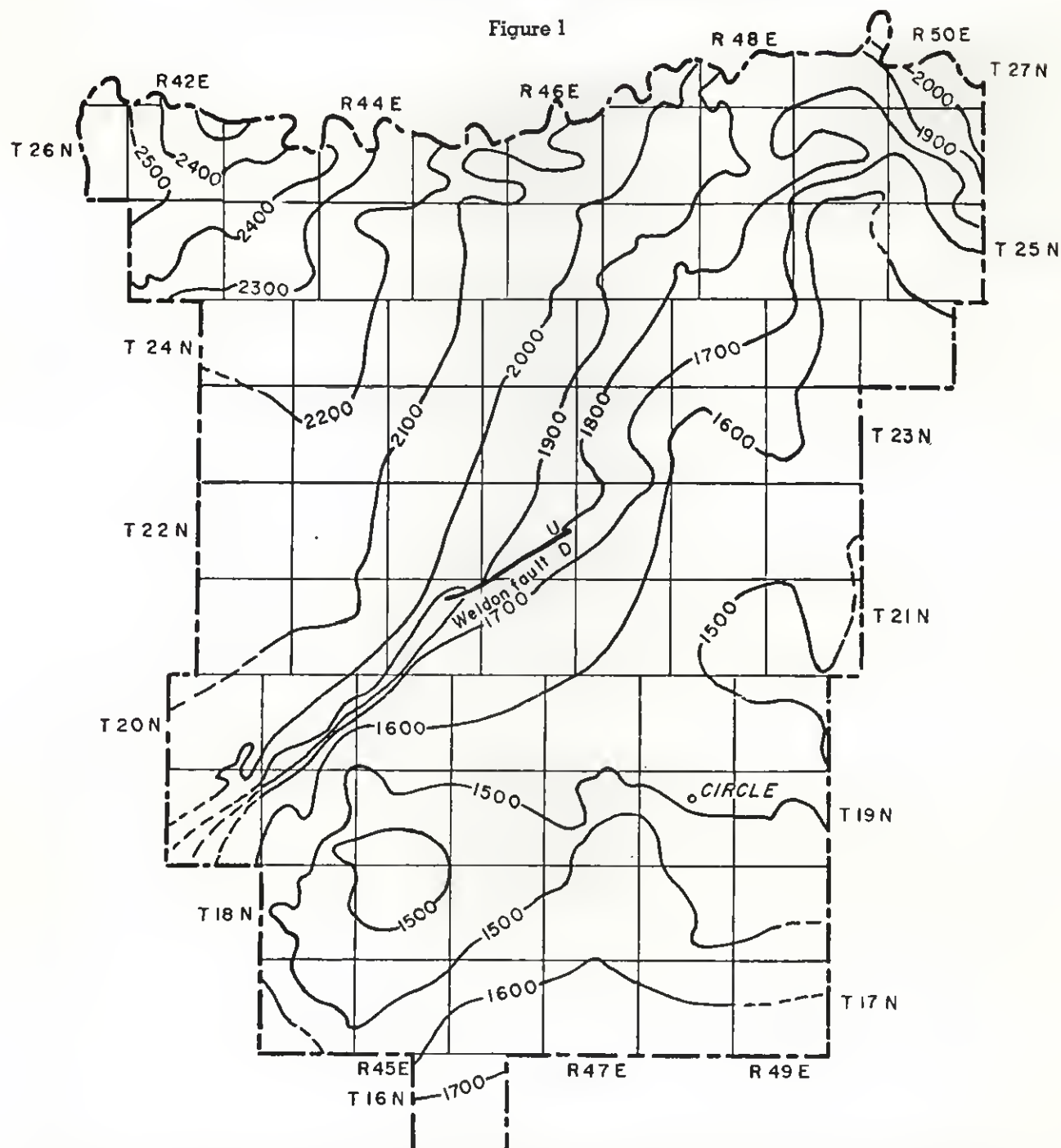
The "Ice Ages" glaciated most of northern Montana. The best evidence of the glacial advance is the presence of erratic granitic boulders. These boulders are not indigenous to eastern Montana, they were carried in by the ice sheet from the Hudson Bay area of Canada. The glacier as it moved south, pushed ahead or carried topsoil which was deposited along the line of its farthest advance. The greatest ice advance covered the northern half of McCone County. Glacial lakes, Jordan and Circle, covered about one-quarter of the county that was not covered by ice. These lakes were formed by the glacier which diverted the Missouri around the ice sheet. The waters became impounded in drainages like the Big Dry Creek, Prairie Elk Creek and the Redwater River. Streams and meltwater filled these prehistoric lakes.

It is believed that there were three separate glacial stages in northeastern Montana. For purposes of simplification in this report, all the glacial deposits will be lumped together as the same age. They are typically 0 to 60 feet thick in this area and composed of boulders, gravel, sand, silt and clay all mixed together.

The courses of the Missouri and Yellowstone Rivers before, during and after the various ice ages are interesting. The pre-glacial path of the Missouri veered off at Poplar, flowed up through

STRUCTURAL GEOLOGY MAP OF McCONE COUNTY

Figure 1



The structural contours show elevation above sea level, not below the surface. The contours are drawn on top of the basal shale member of the Fox Hills formation. This shale member which is up to 200 feet thick lies on top of the 1000+ feet thick Bearpaw shale.

the Medicine Lake area and on into North Dakota. At this time, the Yellowstone River flowed in about the same course as now to the Williston area where it veered north towards the Canadian border, perhaps to join the Missouri. Their exact courses became uncertain beyond the border; however, they did flow into the Hudson Bay.

Glacial Lake Circle formed behind the ice dam which, at one time, lay about ten miles northeast of Circle (see groundwater map). Lake Jordan was a much larger lake in the southwestern townships of McCone County.

The Missouri River joined glacial Lake Jordan and glacial Lake Circle. The advance of glacial ice caused the Missouri River to change its course to the south. The Missouri, at various times, flowed through many temporary paths south of its present position. More research needs to be done in establishing the ancient routes of the Missouri.

Before, during and since the "Ice Ages," streams have been carrying and depositing their sediment load of sand, silt, gravel and clay. This type of accumulation is known as alluvium. There are two alluvial formations studied in this report: the Flaxville and the recent alluvium. The grain size of this deposited sediment is directly related to the velocity of the flow. Large particles such as gravel are deposited by swift water, while smaller particles, namely silt and clay, are carried and dropped by very slow currents. Streams, especially those that meander, can be expected to change their courses somewhat every year. This change may be hardly noticeable, or it may be of major economic and political importance. This changing of channels leaves the old stream gravels to be buried by finer sediments during floods and then to be grown over by vegetation. These buried channels then become shallow, underground aquifers.

The valleys of the Redwater River and other creeks were filled with as much as 30 feet of alluvium. The surfaces of the alluvial flat are now being eroded by entrenched streams. This alluvium is believed to have been deposited since the last glacial advance because it does not have erratic glacial boulders on the top of it or in it. With the coming of the semi-arid climate, the ephemeral streams have cut 30 or more feet into the creek alluvium.

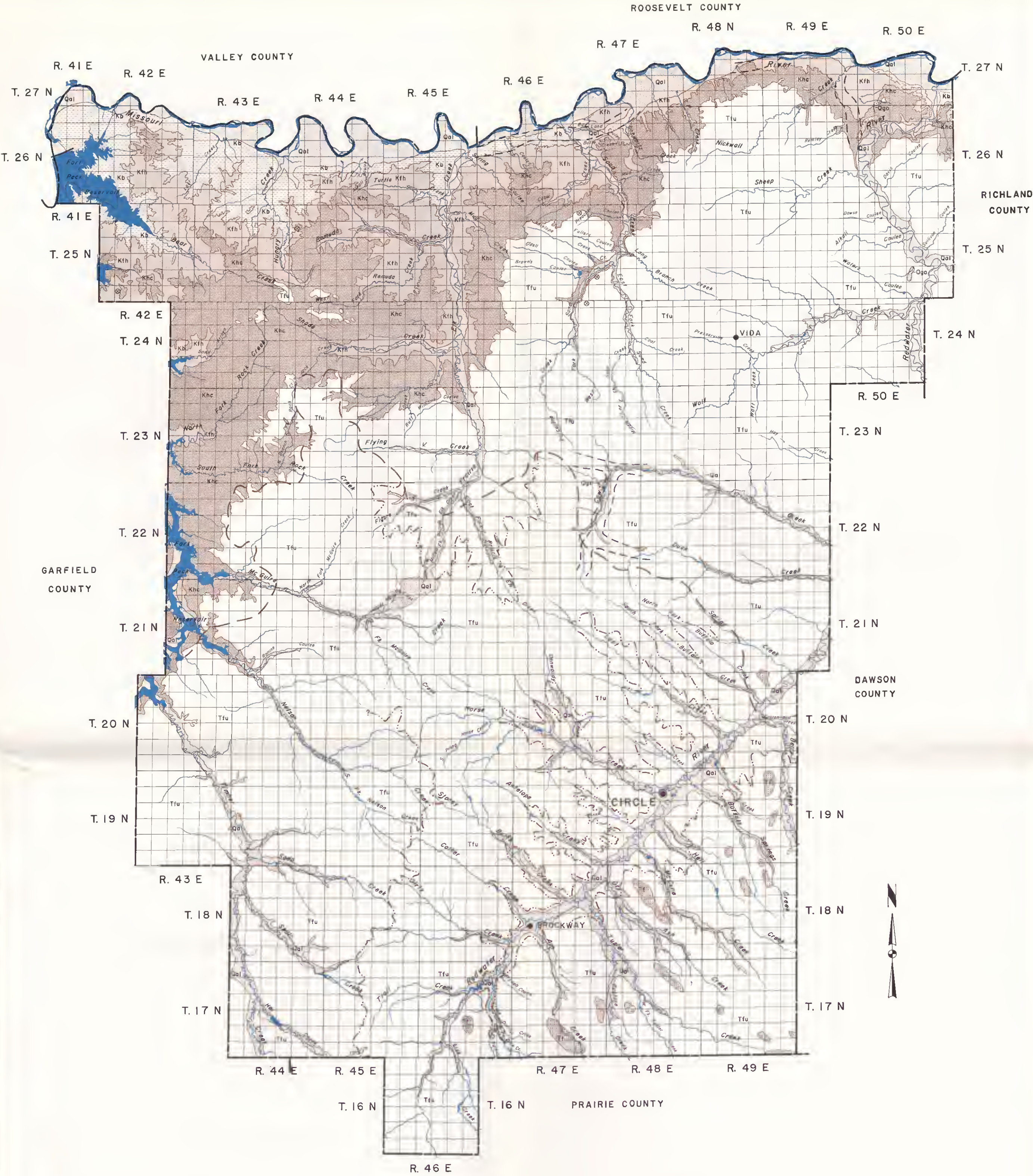
The Missouri has changed courses numerous times, not being in any course long enough to erode a well developed valley as the Yellowstone River. This feature may be seen in the amount of irrigated land in the Yellowstone valley compared to the Missouri's. The Missouri, in some places, has a wide floodplain and no well developed terraces; although, in the stretch between Fort Peck Dam to Virgelle, it has a very narrow valley.

AVAILABILITY OF GROUNDWATER

The following is a description of the various formations with an estimate of their groundwater potential. This study starts with the youngest and shallowest formation and ends with the oldest and deepest.

Alluvium and Colluvium

Recent sand and gravel found along many streams in the state are generally known for an abundance of groundwater. Quite often this water can be reached by digging 10 to 30 feet below the surface. Water from the stream seeps into the sand to move downstream in the alluvium. This



MONTANA WATER RESOURCES BOARD

GROUNDWATER INVENTORY
McCONE COUNTY
COMPILED FROM DATA AVAILABLE AS OF
JULY 1971

Compiled from reports of U.S. Geological Survey,
the Montana Bureau of Mines & Geology and others.

Geologist: Jim Halloran
Drafted by: Dan Nelson, Hugh D. Greenup,
B. June Virag

Scale
0 2 4 6 8 Miles

| EXPLANATION | | | |
|-------------|--|--|--|
| | ALLUVIUM—composed of silt, sand, clay and gravel; along Missouri River yields of 10 to 150 gpm from water saturated sections; along creeks yields are generally poorer | | FOX HILLS—gray to yellowish sandstones and sandy shales; fair to good yields of soft, highly mineralized water |
| | GLACIAL OUTWASH—composed of boulders, sand and clay; no yields reported | | BEARPAW—gray shale, not normally an aquifer |
| | FLAXVILLE—gravel and sand of Flaxville and other ages of similar lithology; too thin and discontinuous for aquifer use | | line of maximum glacial ice advance |
| | FORT UNION—sandstones and shales with many seams of coal and scoria; most widely used aquifer in McCone County; yields of 2 to 30 gpm | | route of ancestral Missouri River; possibly sources of large quantities of groundwater |
| | HELL CREEK—sandstones and shales with a few lignite and subbituminous coal beds; small to prolific yields of highly mineralized water | | line of highest shorelines of glacial Lakes Jordan, Circle and Prairie Elk |
| | | | probable locations of ancestral Missouri River |

water, after it has filtered through the sand for some distance, loses its sediment and most of its disease bacteria. The mineral solution is not filtered out, however. Circulation of groundwater is an important process in preventing it from becoming stagnant and mineralized. Large valleys like the Missouri have valley fill alluvium that may have highly mineralized water in the deeper alluvium and good quality water at a shallower depth near the river. Typical dissolved salts in the Missouri alluvium are sodium, calcium and magnesium cations; and bicarbonates and sulfates anions.

In McCone County, there are economic quantities of alluvial groundwater under the floodplain of the Missouri River. Wells penetrating the alluvium can expect to strike water from 8 to 20 feet below the surface. There is usually sufficient water for stock and domestic needs. There is groundwater in the alluvium of the ephemeral Redwater River, but it is not heavily used due to poor quality and low yield. This alluvium is predominantly fine sediments that are quite thin.

Significant colluvial deposits are present along the sides of the Missouri's floodplain. Colluvium is debris that has been sheet-washed or fallen from steep slopes. A fairly thick, continuous belt of colluvium borders the badlands along the Missouri. Colluvium tends to have more clay than the alluvium; and for this reason, it tends to become more waterlogged and alkaline. Colluvium, as it is being deposited, has little or no clay winnowed out. Alluvium generally is well winnowed and quite permeable. Due to the clay in the colluvium, the permeability is decreased so water may not pass through and becomes trapped by the clay. Colluvium and alluvium interfinger into each other, so that in well cuttings it may be impossible to distinguish the two.

Glacial Deposits

Glacial deposits can be classed in two groups: direct and indirect. A direct glacial deposit would be glacial drift, or a till deposit. An indirect deposit would be glacial lake sediments, glacial outwash and glacial river channel alluvium.

Glacial drift is unconsolidated deposits of everything the glacier carried; that is, boulders, gravel, sand and clay that have been mixed together as till. Drift deposits are often poor sources of groundwater because of the high percentage of clay. Also, it is known that glacial drift carries a relatively high amount of soda, usually present in groundwater as bicarbonate or sulfate.

Typical glacial lake deposits are alternating light and dark laminations of clay with occasional boulders. The boulders floated out on melting icebergs and were dropped into the lake. Lake sediments are poor sources of groundwater due to the extremely fine particle size limiting porosity and permeability. They also are soft and unconsolidated and have been extensively eroded.

Glacial outwash is drift deposited by meltwater streams beyond the ice sheet. These deposits can show sorting and stratification but may be confused with till. The primary difference between the two is the amount of clay in the deposit. Outwash should have significantly less clay than till. The clay was washed out by the running meltwater, thus giving it the name.

This type of outwash deposit may be a fair source of limited supplies of groundwater, if it is of large enough areal extent and limited clay content. Outwash deposits, however, are of random distribution and are not easily detected below the surface. This stratified drift is used by farmers as sources of sand and gravel.

Buried river alluvium deposits were developed by the Missouri River. These deposits were built up in the last one million years or so. The ancient river routes were usually south and 10 to perhaps 300 feet higher than the present Missouri. These former channels, or terraces, are generally covered with glacial drift and slope wash colluvium. These buried alluvium deposits should be good sources of groundwater. The Milk River valley in north central Montana is underlain by alluvium of the ancestral Missouri. The Milk River flows in the old Missouri valley. The Missouri alluvium is a very productive aquifer in this vicinity. It is productive because of adequate recharge and its permeable nature. There should be isolated similar deposits in McCone County. The problem is these deposits may not have enough water storage for heavy use and locating these deposits is also a difficult problem. On the groundwater geology map included, there is drawn in the supposed ancient alluvial deposits formed by the Missouri. In unpublished field notes of W. T. Thom, Jr., 1919 on northern McCone County, gravel terrace remnants were reported at these locations: (Also spotted on groundwater map.)

Sec. 32, T. 25 N., R. 42 E.

Sec. 29, T. 25 N., R. 47 E.

Sec. 7, T. 25 N., R. 44 E.

Sec. 4, T. 24 N., R. 47 E.

Sec. 6, T. 25 N., R. 47 E.

The knowledge is not available as to whether these alluvial deposits contain groundwater. These locations obviously are very general. For the exact locations interpretations of the physiography and geology must be made.

Flaxville Formation

The Flaxville is a gravel formation that forms the caprock on the hills southeast of Circle. The porosity and permeability of the Flaxville gravel causes it to act as a sponge on the flat-topped hills. That is, the water is absorbed instead of running off and eroding.

There are three similar gravel formations lumped together and treated as Flaxville in this report.

The Flaxville is a fluvial gravel very similar to the sands and gravels in the present Yellowstone valley. In fact, many geologists believe the gravel is that of the ancestral Yellowstone River.

By nature, the Flaxville gravel could be a productive aquifer since it is porous and permeable. However, it yields little water for three reasons: (1) it covers only limited areas; (2) it is not recharged to its capacity; and (3) its permeable nature allows rapid percolation of water. On these mesas, the gravel caps are seldom wider than one mile, or not longer than three miles. This means it is less than a half mile to the outcrop. It is only recharged by precipitation in the late spring and early summer which percolates through the gravel to seep out as springs beneath the scarps. There is very little recharge in the winter and early spring because of the frozen ground, and in the late summer and fall seasons there is little precipitation. For adequate recharge, there should be perennial streams crossing the gravel.

Most, if not all, of the water wells drilled into the Flaxville continue on into the Fort Union to yield water from both formations. (The Flaxville in this area is reported to be not thicker than 40 feet.) It is not possible to say just what a Flaxville well will yield by itself.

Fort Union Formation

The Fort Union formation is present under approximately 85 percent of McCone County. Its thickness varies from a featheredge in the northern portion to near 1,400 feet in the center of the county.

Strata of the Fort Union are of continental origin. They represent an environment that may have been similar to that in the Mississippi delta today. It is thought that lowland swamps subsided to a level that allowed the streams to change course and spill out over the swamps. The streams flooded the swamps with sediment thereby burying the organic material. This burial kept the plant debris from being oxidized or burned. A repetitious process like this could explain the cyclic nature of the repeated coal beds, shales and sandstones. Individual beds cannot be traced over great distances.

The Tertiary Fort Union formation is the most widespread and most used aquifer in McCone County. A well, drilled to a depth of 50 to 200 feet, is almost certain to produce adequate water for stock and domestic needs. Sandstones and coal beds generally yield water; if not capping ridges, or too near their outcrop. This formation produces water from the porous sandstone, the very porous scoria beds, and the intensely fractured coal beds. There are at least three separate scoria beds. The quantity of water that can be expected is usually from 5 to 20 gallons per minute. Water from the sandstones is relatively high in soda content and the water from coal is frequently pure and may be lower in soda salts. Fort Union water is often quite soft. Due to presence of sodium bicarbonate, which, if present in sufficient concentration, has deleterious action on soil.

Hell Creek Formation

The Hell Creek formation of Cretaceous geological age consists of massive brown to gray sandstones with interbedded carbonaceous shales. Often the carbonaceous shale grades laterally into shaly lignite. The presence of abundant rust colored concretions is one of the distinguishing features of this formation. The other is the presence of large dinosaur fossils. The concretions are limonite-cemented balls of sandstone which range in size from 1 inch to 6 inches in diameter. Frequently, several of these balls are grown together to form doll-like figures. The soft rock of this formation erodes easily to form badlands. The Hell Creek is exposed in the northwestern corner of the county.

The Hell Creek formation is uppermost Cretaceous in age. The sandstones are believed to have been deposited in a fresh to brackish water environment.

The Hell Creek's depth ranges from the surface in the northwestern corner to about 1,300 feet below the surface and its thickness is 0 to 150 feet. The lower sandstone unit of the Hell Creek is very similar to the underlying Fox Hills sandstone and forms a continuous aquifer with it.

Small to moderate yields of groundwater can be obtained from wells in the formation. Recharge to the formation is by infiltration of precipitation that falls on the outcrops, by seepage from the overlying Fort Union and by infiltration from streams that pass over it.

Fox Hills Formation

The Fox Hills formation consists of fine-grained sandstones, siltstones and shales. It outcrops

McCONE COUNTY STRATIGRAPHIC SECTION

Figure 2

| Rock Unit or Formation (Youngest to Oldest) | Geologic | | Approximate Thickness in Feet | Lithology | Water-Bearing Character |
|--|------------|--------|-------------------------------------|---|---|
| | Age | Symbol | | | |
| Alluvium | Quaternary | Qal | 0 to 40+ | Sand, gravel, silt and clay. | Yields of 5 to 150 gpm reported, with most yields in the range of 10 to 20 gpm. |
| Glacial lake deposits of Lake Circle and Lake Jordan | Quaternary | Qgl | Unreported | Fine sand, silt, and clay; patchy distribution or absent. | Unreported. |
| Glacial river alluvium of the Missouri River | Quaternary | Qra | 0 to 100+ | Sand, gravel, silt and clay. | Unreported but small to moderate yields may be expected. |
| Flaxville | Tertiary | Tf | 0 to 40+ | Sand and gravel; patchy distribution where present. | Unreported. |
| Fort Union | Tertiary | Tfu | 0 to 1200+ | Interbedded buff sandstone and shale, with coal seams. | Yields of 2 to 20 gpm reported, most in the range of 2 to 12 gpm; adequate for ranchers in some instances. |
| Hell Creek | Cretaceous | Khc | 0 to 150 | Interbedded gray-brown sandstone and carbonaceous gray shale. | Yields adequate for ranchers in some instances. The lower part is hydraulically connected with the underlying Fox Hills sandstone. |
| 34 Fox Hills | Cretaceous | Kfh | 150 to 220 | Gray to white massive to thin bedded sandstone, silty and shaly in part. | Yields of 2 to 200 gpm reported; usually adequate for ranchers; and locally adequate for municipal and small-scale industrial uses. |
| Bearpaw | Cretaceous | Kb | 200 to 1200 | Dark colored shale. | Not normally an aquifer. |
| Judith River | Cretaceous | Kjr | 400 to 600 | Interbedded tan sandstone, siltstone, and shale, becoming sandy shale eastward. | Sandstone intervals may yield small to moderate amounts of water locally, often flowing especially near the Missouri bottom land. |
| Claggett | Cretaceous | Kcl | 300 to 500 | Tan-gray shale and sandy shale. | Not normally an aquifer. |
| Eagle | Cretaceous | Ke | 200 to 300 | Gray, white, "salt and pepper" sandstone and gray shale, becoming sandy shale eastward. | Sandstone intervals may yield small amounts of water locally. |
| Telegraph Creek | Cretaceous | Ktc | 50 to 100 | Gray sandy shale. | Not normally an aquifer. |
| Colorado group | Cretaceous | Kc | 2000+ | Dark-colored shales with thin sandstone stringers. | Not normally an aquifer, although sandstones within the interval may locally yield water. |
| Dakota | Cretaceous | Kd | 70 to 100 | Light-colored siltstone and sandstone. | Sandstone intervals may yield small to moderate amounts of water locally. |
| Fuson | Cretaceous | Kf | 50 to 100 | Dark and varicolored shales, locally with light-colored sandstone. | Sandstone may yield moderate amounts of water. |
| Lakota | Cretaceous | Kl | 80 to 150 | White sandstone, locally clay-filled. | Normally yields small to moderate and occasionally large, amounts of potable water. |
| Jurassic interval | Jurassic | Ju | 900 to 1000 | Light-colored sandstone, tan limestone, gray and dark-colored shales. | Sandstone may locally yield small amounts of water. |

in a belt along the Missouri River and in the northwestern corner of the county. The depth to the top of it varies from the surface to about 1,500 feet and in thickness it ranges from 0 to 220 feet.

The Fox Hills is a marine to brackish water deposit and is subdivided into two members. The upper member, the Colgate, is a light gray sandstone.

The geologic structure map (Figure 1) shows the drilling depth to the bottom of the Colgate member. In other words, the depth to the top of a thick shale sequence. The contour elevation figures are relative to sea level, not to surface elevation.

The lower member of the Fox Hills formation is a medium-grained, light brown to yellow brown, or light green sandstone and interbedded shales and silty sandstones.

The sandstones of this formation are water-bearing and yield soft water, which is desirable for domestic and stock usage. The importance of it as an aquifer decreases to the north while it increases toward the southern portion. Most wells that penetrate this formation in the northern townships produce water from the Hell Creek as well as the Fox Hills. The Hell Creek is reported to be the better aquifer and is hydraulically connected with the Fox Hills.

Bearpaw Formation

The Bearpaw shale is a dark gray, slightly sandy, marine shale formation. The Bearpaw is reported to be about 1,200 feet thick at its full section. The shale is tight and usually unproductive of good water. What little that would come from it is too highly mineralized for domestic or stock use.

Judith River Formation

The Judith River formation, directly below the Bearpaw, is another possible source of groundwater. This formation is basically a sandstone, but it has shale beds and numerous coal seams. These sedimentary rocks mostly represent fresh water deposits in the western parts of the plains counties and brackish to marine sediments in the eastern counties.

Groundwater may be found in the Judith River formation in McCone County and could be considered as a reliable source of groundwater. Wells drilled into this formation may be expected to flow, or at least have artesian pressure at the lower elevations in the northern part of the county. The water that comes from this formation usually is salty, but not so much so that it could not be used as an auxiliary stock well. There are several sand members of this formation that yield water of varying quality. Judith River formation water yielded from a well near Frazer had saltier water near the top of the formation than near the bottom. Of the four wells in the source report, the parts per million of dissolved solids ranged from about 2,000 to 4,000 ppm. The water is generally high in sodium and chloride, thus making it rather soft.

Deeper Formations

The Claggett and the Telegraph Creek formations are predominantly sandy shale formations and not considered to be aquifers. The Eagle sandstone, while it is a very good aquifer in north central Montana, is too shaly to yield groundwater in McCone County.

There are deeper formations that have the potential of yielding water. The depths to them are usually not economically feasible for most agricultural and domestic needs. There is also the possi-

bility that in these formations there may be no water, the water may be saline or the water may even be mixed with oil and gas.

WELLS

The largest percentage of water wells in McCone County are being used for stock watering. The number of wells used for stock outnumbers wells used for domestic household needs. As of July 1, 1971, there were 621 well appropriations in the county. There are a number of reported flowing wells in McCone County along the Missouri River bottoms.

The following table is a computer print-out showing some data about selected wells along the Missouri River valley. This table only shows about half the wells in the area south of the river. (See Figure 3.)

Figure 3

| Twp. | Rge. | Sec. | ¼ | Water Use | Total Depth | Inside Diam. | Meth. Lift | Elev. | Static Water Level | Lithology |
|------|------|------|----|-----------|-------------|--------------|------------|-------|--------------------|-----------|
| 26N | 43E | 08 | cb | S | 800 | 5 | F | | F | Kjr |
| 26N | 43E | 09 | ca | U | 12 | 1 | N | | 5 | Qal |
| 26N | 43E | 10 | bb | H | 20 | 1 | P | | | Qal |
| 26N | 43E | 10 | cc | S | 30 | 1 | P | | | Qal |
| 26N | 43E | 24 | aa | U | 27 | 1 | N | | 22 | Qal |
| 26N | 44E | 05 | cc | U | 20 | 1 | N | 2016 | 12 | Qal |
| 26N | 44E | 07 | ad | U | 19 | 1 | N | 2018 | 11 | Qal |
| 26N | 44E | 08 | aa | U | 19 | 1 | N | 2014 | 10 | Qal |
| 26N | 44E | 09 | cc | U | 20 | 1 | N | 2013 | 10 | Qal |
| 26N | 44E | 11 | bb | U | 24 | 1 | N | | 10 | Qal |
| 26N | 44E | 11 | cd | U | 20 | 1 | N | 2012 | 11 | Qal |
| 26N | 44E | 12 | cc | U | 25 | 1 | N | 2013 | 15 | Qal |
| 26N | 44E | 13 | aa | U | 24 | 1 | N | 2013 | | Qal |
| 26N | 44E | 13 | ca | U | 24 | 1 | N | 2015 | 15 | Qal |
| 26N | 44E | 13 | dd | U | 24 | 1 | N | 2012 | 16 | Qal |
| 26N | 44E | 14 | aa | S | 936 | 6 | F | 2023 | F | Kjr |
| 26N | 44E | 14 | cc | U | 21 | 1 | N | | | Qal |
| 26N | 44E | 14 | da | U | 28 | 1 | N | 2016 | 18 | Qal |
| 26N | 44E | 16 | ca | U | 15 | 1 | N | 2011 | 9 | Qal |
| 26N | 44E | 16 | cc | U | 27 | 1 | N | 2012 | 10 | Qal |
| 26N | 44E | 17 | ab | U | 19 | 1 | N | 2016 | 14 | Qal |
| 26N | 44E | 17 | bd | S | 20 | | P | 2013 | | Qal |
| 26N | 44E | 18 | aa | U | 22 | 1 | N | 2015 | 11 | Qal |
| 26N | 44E | 18 | cd | U | 32 | 1 | N | 2021 | 14 | Qal |
| 26N | 44E | 19 | aa | U | 18 | 1 | N | 2016 | 13 | Qal |
| 26N | 44E | 20 | ba | S | 12 | 1 | P | 2014 | | Qal |
| 26N | 44E | 21 | aa | U | 20 | 1 | N | 2019 | 16 | Qal |
| 26N | 44E | 23 | aa | U | 30 | 1 | N | 2022 | 24 | Qal |
| 26N | 45E | 17 | cb | U | 18 | 5 | N | | 16 | Qal |
| 26N | 45E | 17 | cd | U | 26 | 18 | N | | 22 | Qal |
| 26N | 45E | 18 | aa | U | 21 | 1 | N | 2005 | 10 | Qal |
| 26N | 45E | 18 | ae | S | 22 | 1 | P | 2006 | | Qal |

Figure 3 — (Continued)

| Twp. | Rge. | Sec. | ¼ | Water Use | Total Depth | Inside Diam. | Meth. Lift | Elev. | Static Water Level | Lithology |
|------|------|------|----|--------------|----------------|-----------------|---------------|-------|--------------------------|-----------|
| 26N | 46E | 09 | cc | H | 96 | 8 | P | | 53 | Qal |
| 26N | 46E | 10 | ba | S | 30 | 1 | P | | 25 | Qal |
| 26N | 46E | 10 | bb | S | 30 | 1 | P | | 24 | Qal |
| 26N | 46E | 10 | ca | H | 79 | 4 | P | | 33 | Qal |
| 26N | 46E | 12 | bb | S | 26 | 1 | P | | 18 | Qal |
| 26N | 46E | 13 | aa | U | 80 | 4 | P | | 42 | Qal |
| 26N | 46E | 14 | aa | | 10 | 48 | | 2039 | 6 | Qal |
| 26N | 46E | 14 | ba | | 1100 | | | | | Kjr |
| 26N | 46E | 14 | cb | | | | F | | F | ? |
| 26N | 46E | 18 | cd | H | 47 | 36 | P | | 46 | Qal |
| 26N | 47E | 06 | cb | H | 52 | 6 | P | | 22 | Qal |
| 26N | 47E | 09 | aa | H | 72 | 6 | P | | 60 | Qal |
| 26N | 47E | 10 | ba | U | 78 | 6 | N | | 59 | Qal |
| 26N | 47E | 10 | bc | U | 46 | 8 | N | | | Qal |
| 27N | 47E | 23 | dd | | | 1 | P | | | ? |
| 27N | 47E | 24 | ca | S | | 1 | P | | | ? |
| 27N | 47E | 25 | ad | U | | 1 | P | | 7 | ? |
| 27N | 47E | 25 | dd | H | 20 | 1 | P | | 10 | Qal |
| 27N | 47E | 27 | ac | H | 23 | | B | | 17 | Qal |
| 27N | 47E | 34 | ca | H | 17 | 1 | P | | 9 | Qal |
| 27N | 47E | 35 | ba | U | 21 | 1 | N | 1983 | 9 | Qal |
| 27N | 47E | 35 | db | H | 32 | 1 | P | | 28 | Qal |
| 27N | 47E | 36 | ad | H | 29 | 1 | P | | 22 | Kfh |
| 27N | 48E | 14 | dd | H | 30 | 1 | P | | 18 | Qal |
| 27N | 48E | 15 | ca | H | 25 | 1 | P | | 20 | Qal |
| 27N | 48E | 19 | db | S | 40 | 1 | P | | 14 | Qal |
| 27N | 48E | 19 | db | H | 37 | 1 | B | | 14 | Qal |
| 27N | 48E | 20 | cc | H | 35 | 1 | P | | 15 | Qal |
| 27N | 48E | 22 | bb | S | 35 | 1 | P | | 14 | Qal |
| 27N | 48E | 22 | bc | H | 25 | 1 | P | | 14 | Qal |
| 27N | 48E | 23 | cd | H | 35 | 1 | P | | 30 | Khc |
| 27N | 48E | 27 | ad | | 120 | 6 | P | | | Khc |
| 27N | 48E | 27 | ba | H | 14 | 36 | P | | 12 | Qal |
| 27N | 48E | 28 | aa | | 28 | 36 | | | 24 | Qal |
| 27N | 48E | 28 | bd | H | 115 | 6 | J | | 70 | Khc |
| 27N | 48E | 30 | db | H | 28 | 1 | P | | 14 | Qal |
| 27N | 48E | 31 | ac | H | 93 | 6 | P | | 61 | Khc |
| 27N | 48E | 32 | ba | S | 26 | 12 | P | | 19 | Kfh |
| 27N | 50E | 20 | db | U | 38 | 6 | P | | 11 | Qal |
| 27N | 50E | 22 | ac | H | 28 | 1 | P | | 16 | Qal |
| 27N | 50E | 22 | bc | | 55 | 6 | P | | 14 | Qal |
| 27N | 50E | 25 | dc | H | 58 | 4 | P | | 21 | Qal |
| 27N | 50E | 26 | ba | H | | 1 | P | | 13 | ? |
| 27N | 50E | 27 | ba | U | 27 | 6 | P | | 15 | Qal |
| 27N | 50E | 35 | ba | U | 37 | 6 | N | | 28 | Qal |

WELL NUMBERING: SEE EXPLANATION BELOW.

Water Use: S, stock; U, unused; H, domestic.

Total Depth: in feet below land surface.

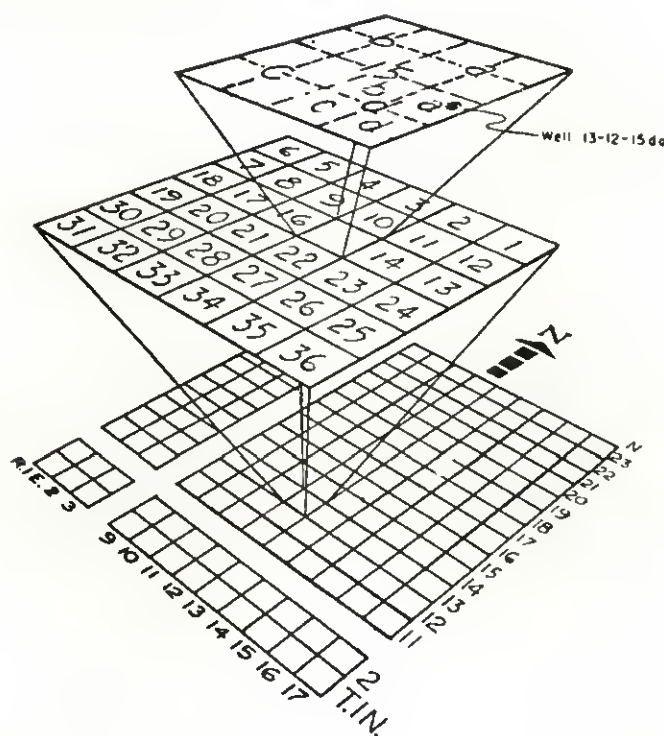
Inside Diameter: inside casing diameter.

Method of Lift: C, centrifugal; Cy, cylinder; F, natural flow; J, jet; N, none; P, pitcher pump; Pl, plunger.

Elevation: height in feet above sea level.

Static Water Level: depth to water table.

Lithology: the rock formation producing the water.



SPRINGS

Springs in McCone County are scattered around with little pattern. Springs occur where the land surface intersects the water table. They are often found at the base of an exposure of sandstone underlain by clay or shale. The springs in McCone County are generally found in the coulees that cut deep into the Fort Union formation. The Redwater River has cut deep into the Fort Union, explaining the slight increase in density of springs near this river valley. Springs often show up in the spring of the year, but dry up in late summer.

The use of springs historically dates back to the mid-1880's. Springs were predominantly used for stock watering then, as they are now.

There are 85 appropriated springs on file with the Montana Water Resources Board, as of January 1, 1971.

WATER QUALITY ANALYSIS

This Water Resources Survey has included a table of water analysis data. This information is available in, and is taken from, the U. S. Geological Survey Water-Supply Paper 1263; and the Montana State Department of Health, "Chemical Analysis of Municipal Water Supplies". This data is republished in this Survey for the convenience of residents of McCone County and other interested people.

Figure 4
(Parts per Million)

| Constituent | Alluvium | | Fort Union, Hell Creek Formations | | Judith River Formation | |
|----------------------------|----------|---------|-----------------------------------|---------|------------------------|---------|
| | Maximum | Minimum | Maximum | Minimum | Maximum | Minimum |
| Sodium + potassium..... | 719 | 23 | 865 | 340 | 1,500 | 968 |
| Bicarbonate..... | 1,100 | 351 | 1,950 | 882 | 869 | 482 |
| Carbonate..... | 0 | 0 | 131 | 0 | 50 | 0 |
| Chloride..... | 57 | 5.3 | 116 | 6.0 | 2,050 | 458 |
| Fluoride..... | .8 | .0 | 4.8 | 1.0 | 1.8 | 1.0 |
| Boron..... | .50 | .06 | .97 | .00 | 5.16 | 4.65 |
| Dissolved solids..... | 2,780 | 829 | 2,000 | 1,000 | 4,130 | 2,430 |
| Total hardness..... | 995 | 220 | 167 | 25 | 186 | 46 |
| Noncarbonate hardness..... | 349 | 0 | 0 | 0 | 0 | 0 |
| Percent sodium..... | 84 | 4 | 97 | 80 | 98 | 93 |

Range of several mineral constituents in groundwater of the Missouri River alluvium and the Fort Union, Hell Creek and Judith River formations from wells along the Missouri.

Figure 5 shows the results of a water quality analysis of Circle's municipal water supply. This analysis was made by the State Department of Health in August of 1967.

Figure 5

| Well | Total Solids | Hardness | Ca | Mg | Na K | CO ₃ | HCO ₃ | SO ₄ | Cl | Fe | F |
|-----------|--------------|----------|----|----|------|-----------------|------------------|-----------------|----|-----|-----|
| Circle | | | | | | | | | | | |
| #1 | 2552 | 25 | 10 | 0 | 946 | 24 | 810 | 1250 | 22 | 0.2 | 2.3 |
| #2 | 2200 | 115 | 18 | 17 | 784 | 30 | 866 | 940 | 20 | 0.2 | 2.5 |
| #3 | 2070 | 65 | 14 | 7 | 746 | 42 | 866 | 841 | 19 | 0 | 2.6 |
| #4* | 2520 | 138 | 20 | 22 | 880 | 12 | 910 | 1195 | 23 | 3.5 | 2.6 |

*This is a composite sample of the first three wells and was sampled in October, 1966.

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ECONOMIC MINERAL DEPOSITS

Nonmetallic Minerals

The Bearpaw Shale is exposed in the northwestern part of McCone County, along the Milk River. Although commercial bentonite deposits occur within this formation elsewhere in Montana, no bentonite deposits of commercial significance have been reported from McCone County.

Oil and Gas

Shell Oil Company's discovery of Richey field in November, 1951, initiated Montana's Williston Basin production. By the end of 1968 the field had produced almost 2 million barrels of oil. No production was recorded in the Montana Oil and Gas Commission's Annual Review for 1969.

Since the discovery of Richey field, about 175 wells have been drilled in the search for oil and gas. Of these, 56 produced oil and 119 were dry. Nineteen wells were drilled in the county during 1969 and only one of these found production.

Richey, Southwest Richey, Vida, and Weldon fields have produced over 8.5 million barrels of oil from McCone County. About 595,000 barrels of oil were produced during 1969.

The Kibbey and Charles formations of Mississippian age have produced most of the oil. Devonian and Silurian beds are also productive, and the Ordovician rocks may be potentially productive.

Coal

The coal resources of McCone County consist of lignite, occurring principally in the Tongue River Member of the Fort Union formation. Through work by A. J. Collier and M. M. Knechtel published in U. S. Geological Survey Bulletin 905, titled "The Coal Resources of McCone County, Montana,"

R. B. Berg, economic geologist, Nonmetallic Mineral Resources Division; C. A. Balster, research petroleum geologist, Mineral Fuels Division (Billings branch office); R. E. Matson, coal geologist; Mineral Fuels Division, and by R. E. Matson, whose work is published in Montana Bureau of Mines and Geology Bulletin 78, both total reserves and strippable reserves have been estimated. Collier and Knechtel estimated the total lignite reserves in the Tongue River Member in excess of 15 billion tons. Strippable reserves estimated by Matson total 1,366 million tons.

Although the total lignite reserves in McCone County are very large, future commercial development of the lignite will most likely be limited to lower cost lignite mineable by surface methods. Two separate areas where surface mining will be practical have been named the Redwater deposit and the Weldon-Timber Creek deposit.

The Redwater deposit includes much of the drainage and low valley sides along Redwater Creek, northeast of Circle. Strippable coal occurs in the S coal bed, which has a thickness varying from 8 to 88 feet. In quality the coal is ranked as lignite A. Total strippable reserves are estimated at 642 million tons.

The Weldon-Timber Creek deposit occurs in the western part of McCone County, extending from Weldon southwest to Timber Creek. Strippable coal occurs near the surface exposure or the burned outcrop area of the S coal bed. The S coal bed varies in thickness from 8 to 20 feet. The coal is ranked as lignite A and the total strippable reserves are estimated at 724 million tons.

SOIL AND WATER CONSERVATION DISTRICT

McCone County, an area of 1,660,160 acres or 2,594 square miles, is served by the McCone Soil and Water Conservation District which was organized in 1942. The District is governed by seven supervisors, five who are elected by rural residents of McCone County and two who are appointed by the mayor of Circle, the county seat of McCone County. The objective of the two city officials is to acquaint the urban people, who comprise a large percent of the total population of the District, with the need for soil and water conservation and proper resource management.

The District carries out a program of complete resource evaluation and conservation including erosion control, water conservation, soil management, land improvement, wildlife management, environmental protection, pollution abatement, recreation, and land adjustment to proper use. This program is accomplished by providing technical assistance to groups and individual farmers and ranchers, on a voluntary basis, by analyzing all resources, and planning and applying economically sound conservation treatment.

Under State law, the supervisors have the power to call upon local, state, and federal agencies to assist in carrying on a soil and water conservation program. The McCone Soil and Water Conservation District has memoranda of understanding with the Soil Conservation Service, Extension Service, State Forestry Department, and the Bureau of Land Management to provide technical assistance to District cooperators in carrying out sound soil and water conservation programs. Close working relations are maintained with the Farmers Home Administration, Agricultural Stabilization and Conservation Service, State Fish and Game Department, and USDA Councils for Rural Development. The District also works closely with local and regional associations for Economic Development.

The Soil Conservation Service assists the District by furnishing and interpreting basic data on soils and plant cover and other resources. Technical data are interpreted in terms of acceptable alternative land uses and treatments to help guide the farm and ranch operators and the urban population in developing sound individual or group conservation plans and Great Plains contracts. It also aids cooperators in performing operations requiring technical skills beyond the experience of the individuals involved.

The Extension Service assists the District with its education and information program. An important function of the District is to inform landowners and occupiers of the benefits derived from the wise use of the communities' soil, water and other natural resources.

The State Fish and Game Department cooperates in matters involving streams, lakes, ponds and other wildlife aspects of the program.

Technical phases of the District's program include detailed soil surveys, range site and condition classes, groundwater investigations, drainage studies, irrigation potentials, topographic and other engineering conservation treatments. With this information and by counseling with conservation technicians, the cooperator makes the final decisions on land use and treatment that will enable him to treat the hazards and limitations that occur on each tract of land. These decisions are recorded in the Great Plains contracts or conservation plans. The cooperator determines what will be done on his farm or ranch and when the jobs will be carried out. After the contract or plan is completed, the cooperator is given further technical assistance on design and layout work essential to establishing conservation practices on the land as previously planned.

There are approximately 4,310 acres of irrigated cropland, 489,375 acres of non-irrigated cropland, 895,226 acres of pasture and rangeland, 4,453 acres of woodland, and 21,436 acres of other lands such as water, roads, townsites, airports, and highways on which the District shares a conservation responsibility. There are 246,466 acres of federal lands controlled by the Bureau of Land Management. This is mostly rangeland.

The major enterprises on agricultural lands are grain and livestock production. Beef cattle, sheep and swine are produced. Much of the range for beef-type cattle is provided through lease of Bureau of Land Management lands. Cash crops besides grains are safflower and hay.

Work done on cropland since the organization of the District consists largely of improved cropping systems, improved management of crop residues, improvement and installation of irrigation systems—both sprinkler and flood, seeding of pastures and haylands to adapted grasses and legumes, installation of water and erosion control structures, farm drainage systems, soil management, and improvement of wildlife habitat. On dryland pasture and range, the work has consisted of improvement of existing cover by proper range use, fencing, livestock water development and improvement, and improvement of wildlife habitat.

Since the District was organized, assistance has been given on proper cropping systems and residue management on 68,635 acres, one sprinkler irrigation system, 78 surface irrigation systems, 38 irrigation reservoirs, 1,040 structures for water and erosion control, 206 miles of irrigation canal and field ditches, 8,012 acres of hay and pasture planted, pasture and hayland management on 50,388 acres, 877 livestock water ponds constructed, 548 acres of farmstead and feedlot windbreaks planted, 666 miles of field windbreaks established, 20 ponds stocked with fish, and wildlife habitat preservation (natural areas) and planting on 1,131 acres, 740 acres of brush control on rangeland, 172 diversion dams constructed, 3,729 acres of land leveled, 41,652 feet of pipeline for livestock water installed, 52,646 acres of deferred grazing on rangeland, 343,936 acres of wind strip cropping, and 712,424 acres of stubble mulching.

A conservation Needs Inventory was published in 1970 for McCone County as a part of a national inventory of needs. It was estimated that about 76 percent of dryland cropland and irriga-

ted cropland, and 32 percent of grasslands were in need of additional conservation treatment.

A considerable amount of the conservation work has been accomplished through efforts of organized groups and this is encouraged wherever possible.

Currently, the McCone Soil and Water Conservation District is a leader in Resource Development in eastern Montana. Foresightedness of the District has been shown in its interest and leadership in the Water Conservancy District proposal and by its participation in the Eastern Montana Economic Development Association.

Cooperative efforts of landowners and operators, local, state, and federal agencies, civic organizations, local businessmen, and news media have contributed to the overall success of the District.

FISH AND GAME

Diverse habitat types throughout this county produce an exceptional variety of both big and small game species. Hunter access is excellent due to large tracts of land in public ownership through most of the county.

Large populations of mule deer, whitetail deer and antelope are present in the county. Mule deer are found in the rough badlands and "breaks" of the northwestern and western part of the county, and whitetails are most numerous along the bottom lands of the Missouri and Redwater Rivers. Antelope occupy the sagebrush grassland areas.

Sharptail grouse provide excellent upland bird hunting opportunities, but it is not uncommon for hunters to bag sharptails, sage grouse and Hungarian partridge in one outing. Good pheasant populations occur on Missouri River bottom lands and brushy main tributaries.

The large number of stockwater dams constructed on both public and private lands in the county contribute substantially to waterfowl production in this part of the State.

Small reservoirs, the Missouri River and Fort Peck Reservoir provide ample fishing opportunities. The Missouri is popular for catches of sauger, walleye and northern pike, catfish and gold-eyes. Small reservoirs provide angling for both trout and warm water species. The Big Dry Arm of Fort Peck Reservoir is a good producer of northern, walleye and sauger pike, coho salmon, catfish, crappie, perch, drum and an occasional rainbow trout.

WATER RESOURCES SURVEY

McCone County, Montana

PART II

**Irrigation Development with Maps Showing Irrigated
Areas in Colors Designating Sources of Supply**

Published by
MONTANA WATER RESOURCES BOARD
Sam W. Mitchell Building
Helena, Montana 59601
September, 1971

WATER RIGHT DATA AND IRRIGATION BY STREAMS
(Filings of Record)

| APPROPRIATIONS | | | | | | | | | | DECEDED RIGHTS | | | | IRRIGATION SUMMARY | | | |
|----------------------|--|--------------------------|---------------------------|-------------------|---------------------|-------------|-------------------|-------------------|---------------------|--|---|---|------|--------------------|--|--|--|
| *Locust | STREAM | 1/No. of Us Rights | No. of Filed Rights | Miner's Inches | Cu. Ft. Per Sec. | Case No. | No. of Decrees | Miner's Inches | Cu. Ft. Per Sec. | Present Irrigated Acres 2/Regular 3/Flood | Irrigable Acres Under Present Facilities 2/Regular 3/Flood | Maximum Irrigated and Irrigable Acres Under Present Facilities 2/Regular 3/Flood | | | | | |
| MISSOURI RIVER BASIN | | | | | | | | | | | | | | | | | |
| 27N-50E | **Missouri River | 1 | 51 | 138,620.00 | 3,485.50 | | | | | 4,516.00 | 0.00 | 4,994.00 | 0.00 | | | | |
| 20N-43E | Timber Creek | 1 | 6 | 13,600.00 | 340.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 17N-44E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 15.00 | 0.00 | | | | |
| 17N-44E | Hay Creek | 1 | 1 | 200.00 | 5.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 17N-44E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 17N-45E | Unnamed Tributary | 1 | 1 | 80.00 | 2.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 17N-44E | Unnamed Tributary | 1 | 1 | 80.00 | 2.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 17N-44E | Unnamed Tributary | 1 | 1 | 80.00 | 2.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 18N-44E | Skull Creek | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 51.00 | 0.00 | | | | |
| 17N-45E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 17N-44E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 19N-44E | Soda Creek | 1 | 1 | 250.00 | 6.25 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 19N-44E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 18N-44E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 18N-44E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 21N-43E | Nelson Creek | 1 | 3 | 700.00 | 17.50 | | | | | 0.00 | 0.00 | 10.00 | 0.00 | | | | |
| 20N-45E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 20N-45E | S. F. Nelson Creek (Nelson Creek) | 3 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 19N-45E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 19N-45E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 20N-45E | Unnamed Tributary | 2 | 1 | All | All | | | | | 5.00 | 3.00 | 0.00 | 0.00 | | | | |
| 20N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 20N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 21N-43E | Romine Coulee | 1 | 2 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 21N-43E | (East Fork of) McGuire Creek | 3 | 9 | 16,140.00 | 403.50 | | | | | 149.00 | 0.00 | 61.00 | 0.00 | | | | |
| 21N-43E | Upper McGuire Creek | 1 | 1 | 0.00 | 0.00 | | | | | 18.00 | 40.00 | 56.00 | 0.00 | | | | |
| 21N-45E | Unnamed Tributary | 1 | 2 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 21N-45E | S. Fork McGuire Creek | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 21N-45E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 21N-44E | N. Fork (East Fork) McGuire Creek | 1 | 0 | 1,000.00 | 40.00 | | | | | 7.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-43E | S. Fork Rock Creek | 1 | 1 | 300.00 | 7.50 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-44E | N. Branch S. Fork Rock Creek | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-43E | N. Fork Rock Creek | 1 | 2 | 300.00 | 7.50 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-42E | Unnamed Tributary | 1 | 1 | 2A/F*** | 3.75 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-42E | Bear Creek | 1 | 1 | 150.00 | 3.75 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-42E | Westra Coulee | 1 | 1 | 240.00 | 6.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-42E | Cassidy Coulee | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-43E | School Coulee | 1 | 1 | 45.00 | 1.15 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-43E | Farmer Coulee | 1 | 1 | 45.00 | 1.15 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-43E | Unnamed Coulee | 1 | 1 | 200.00 | 5.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-43E | Unnamed Coulee | 1 | 1 | 200.00 | 5.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-43E | Hungry Creek | 1 | 1 | 2,281.48 | 57.01 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-43E | Pasture Creek | 2 | 2 | 480,232.00 | 12,005.80 | | | | | 144.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-44E | Does Coulee | 2 | 2 | 468.00 | 11.70 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-44E | McGill (Big Miller) (First) Coulee | 4 | 4 | 9,435.00 | 235.87 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-44E | Alkali (Will) Coulee | 1 | 1 | 6,000.00 | 150.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-44E | Prairie Elk Creek | 3 | 3 | 1,468.00 | 36.70 | | | | | 0.00 | 65.00 | 0.00 | 0.00 | | | | |
| 26N-45E | Middle Fork (West Main Fork) Prairie Elk | 1 | 1 | 1,480.00 | 37.00 | | | | | 34.00 | 0.00 | 0.00 | 0.00 | | | | |
| 22N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 22N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 22N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 22N-45E | E. Fork Prairie Elk Creek | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 22N-46E | Unnamed Tributary | 1 | 1 | 1,000.00 | 25.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-46E | Runoff | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-46E | Runoff (Unnamed Tributary) | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-46E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-46E | Dry Coulee (Unnamed Tributary) | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 15.00 | 0.00 | | | | |
| 23N-46E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-46E | Williams Coulee | 1 | 1 | 400.00 | 10.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-47E | (N. Fork of) Snake Creek | 1 | 1 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 16.00 | 0.00 | | | | |
| 24N-44E | Jack Creek | 0 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 14.00 | 0.00 | | | | |
| 24N-44E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-45E | Spring | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-45E | Remuda (Remutha) Creek | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-45E | West Fork Remuda (Remutha) Creek | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-44E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-45E | Unnamed Tributary | 2 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-46E | Mud Creek | 1 | 2 | 1,025.00 | 25.62 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-46E | Unnamed Tributary | 1 | 2 | 12.00 | 0.30 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-45E | Turtle Creek | 1 | 1 | All | All | | | | | 16.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-45E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-45E | Spring Coulee | 1 | 1 | 25.00 | 0.62 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-46E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-46E | Boggy Spring Coulee | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-46E | Steele Coulee | 1 | 2 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-46E | Dry (Rens Creek) Coulee | 2 | 2 | 3,025.00 | 75.62 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-46E | Unnamed Tributary | 1 | 2 | 200.00 | 5.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-46E | Unnamed Tributary | 1 | 1 | 349.00 | 8.73 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | West Fork Sand Creek and Tributaries | 1 | 1 | All | All | | | | | 86.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-47E | Unnamed Tributary (Porcupine Creek) | 1 | 0 | 800.00 | 20.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-47E | Porcupine Creek | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-47E | Unnamed Tributary | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 21.00 | 0.00 | | | | |
| 25N-47E | Browns Coulee | 1 | 1 | All | All | | | | | 17.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | Y-Dell Coulee | 1 | 1 | 25.00 | 0.62 | | | | | 265.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | Unnamed Tributary | 1 | 1 | 25.12 | 0.63 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | Antelope Creek | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | East Fork Sand Creek | 1 | 4 | 345.00 | 8.62 | | | | | 68.00 | 0.00 | 37.00 | 0.00 | | | | |
| 24N-47E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-47E | Middle Fork of E. Fork (Central Fork) Sand Creek | 1 | 3 | All | All | | | | | 13.00 | 0.00 | 0.00 | 0.00 | | | | |
| 23N-47E | Unnamed Tributary | 1 | 3 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-47E | Unnamed Tributary | 1 | 1 | 25.00 | 0.62 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-47E | Barred Springs | 1 | 1 | 25.00 | 0.62 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 24N-47E | Unnamed Tributary | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | Long Branch Creek | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | Fullers Coulee | 2 | 2 | 525.00 | 13.12 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | Unnamed Creek | 1 | 1 | 25.00 | 0.62 | | | | | 0.00 | 0.00 | 28.00 | 0.00 | | | | |
| 25N-47E | Bad Land Coulee | 1 | 1 | 25.00 | 0.62 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | Unnamed Tributary | 2 | 2 | 1,000.00 | 25.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 25N-47E | Teacher Coulee | 1 | 1 | All | All | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-47E | Dry Coulee | 2 | 2 | 525.00 | 13.12 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-47E | Unnamed Tributary | 2 | 2 | 525.00 | 13.12 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-46E | Crow Creek | 1 | 0 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-46E | Unnamed Tributary | 1 | 1 | 18,3A/F*** | 18,3A/F*** | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-47E | Butte Creek | 1 | 1 | 463.73 | 11.60 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-47E | Bad Land Coulee | 1 | 1 | 25.00 | 0.62 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 26N-47E | Marlin Coulee | 1 | 1 | 25.00 | 0.62 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 27N-47E | Schwartz (Swarts) Creek | 2 | 1 | All | All | | | | | 152.00 | 0.00 | 0.00 | 0.00 | | | | |
| 27N-47E | Unnamed Tributary | 1 | 1 | 60.44 | 1.51 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | | | |
| 27N-47E | Well | 1 | 1 | 39.00 | 0.98 | | | | | 83.00 | 0.00 | 0.00 | 0.00 | | | | |
| 27N-48E | Well | 1 | 1 | 2,000.00 | 50.00 | | | | | 128.00 | 0.00 | 0.00 | 0.00 | | | | |
| 27N-48E | Well | 1 | 1 | | | | | | | | | | | | | | |

*The township and range shown in the locator column indicates either where a stream enters the next larger drainage or where a stream or drainage leaves the county.

**Names of streams indented on the left hand margin indicate that they are tributaries of the first stream named above which is not indented.

***Filings made in acre-feet are not included in the total

4) Filings made in acre-feet are not included in the total.

Regular irrigation includes all lands which receive water that can be regulated and/or managed. If water can be turned on when needed, and turned off when not needed, it is classified as regular irrigation. This includes dike systems

that can be controlled by gates or shut-off flumes.

| DRAINAGES NOT LOCATED IN McCONE COUNTY | | | | | | |
|--|----------------|----------------|------------------|--------------------------|----------------|----------------|
| Name of Stream | No. of Filings | Miner's Inches | Cu. Ft. Per Sec. | Name of Stream | No. of Filings | Miner's Inches |
| East Fork of Spring Creek..... | 1 | 1,000.00 | 25.00 | Davis Creek | 1 | 300.00 |
| Robbers Roost Spring..... | 1 | 100.00 | 2.50 | Big Coulee | 1 | 500.00 |
| Gentry's Coulee | 1 | 75.00 | 1.88 | A Dry Creek | 1 | 12.50 |
| Jims Coulee | 1 | 56.25*** | 56.25*** | Unnamed Coulee | 1 | 500.00 |
| Milk River Coulee | 1 | 1,000.00 | 25.00 | Two Coulees | 1 | 300.00 |
| Colgan Creek | 1 | 8,000.00 | 200.00 | Unnamed Reservoirs | 5 | 25.12 |
| Sushee Coulee | 1 | 200.00 | 25.00 | Asa Creek | 1 | 500.00 |

**SUMMARY OF IRRIGATED LAND BY RIVER BASINS IN THE
FOLLOWING COUNTIES COMPLETED TO DATE**

Big Horn, Blaine, Broadwater, Carbon, Carter, Cascade, Chouteau, Custer, Dawson, Deer Lodge, Fallon, Flathead, Gallatin, Glacier, Golden Valley, Granite, Hill, Jefferson, Judith Basin, Lake, Lewis & Clark, Liberty, Lincoln, Madison, **McCone**, Meagher, Mineral, Missoula, Musselshell, Park, Phillips, Pondera, Powder River, Powell, Prairie, Ravalli, Richland, Rosebud, Sanders, Silver Bow, Stillwater, Sweet Grass, Teton, Toole, Treasure, Valley, Wheatland, Wibaux and Yellowstone.

| RIVER BASIN | Present Irrigated Acres | Irrigable Acres Under Present Facilities | Maximum Irrigated & Irrigable Acres Under Present Facilities |
|--|-------------------------------|--|---|
| Hudson Bay Drainage | | | |
| *Hudson Bay..... | 0.00..... | 0.00..... | 0.00 |
| Nelson River..... | 0.00..... | 0.00..... | 0.00 |
| Lake Winnipeg..... | 0.00..... | 0.00..... | 0.00 |
| Saskatchewan River..... | 0.00..... | 0.00..... | 0.00 |
| Oldman River..... | 0.00..... | 0.00..... | 0.00 |
| St. Mary River..... | 587.00..... | 0.00..... | 587.00 |
| Unnamed Coulee..... | 26.00..... | 0.00..... | 26.00 |
| Kennedy (Otatso) Creek..... | 0.00..... | 71.00..... | 71.00 |
| Willow Creek..... | 0.00..... | 4.00..... | 4.00 |
| Grand Total Hudson Bay Drainage Basin..... | 613.00..... | 75.00..... | 688.00 |
| Missouri River Drainage Basin..... | | | |
| Missouri River..... | 149,004.50..... | 30,313.33..... | 179,317.83 |
| Jefferson River..... | 61,291.00..... | 9,713.00..... | 71,004.00 |
| Beaverhead River..... | 40,771.00..... | 6,076.00..... | 46,847.00 |
| Big Hole River..... | 23,775.00..... | 1,950.00..... | 25,725.00 |
| Madison River..... | 39,445.00..... | 7,660.00..... | 47,105.00 |
| Gallatin River..... | 112,054.00..... | 21,242.00..... | 133,296.00 |
| Smith River..... | 32,934.00..... | 19,679.00..... | 52,613.00 |
| Sun River..... | 124,474.58..... | 4,385.00..... | 128,859.58 |
| Maries River..... | 149,004.42..... | 20,756.88..... | 169,761.30 |
| Teton River..... | 74,653.00..... | 15,882.33..... | 90,535.33 |
| Musselshell River..... | 64,789.00..... | 57,870.00..... | 122,659.00 |
| Milk River..... | 217,402.62..... | 50,044.76..... | 267,447.38 |
| Yellowstone River**..... | 375,720.09..... | 99,861.96..... | 475,582.05 |
| Stillwater River**..... | 30,423.50..... | 8,028.53..... | 38,452.03 |
| Clarks Fork River*..... | 88,160.97..... | 1,530.83..... | 89,691.80 |
| Big Horn River..... | 65,005.00..... | 23,858.00..... | 88,863.00 |
| Tongue River..... | 28,170.00..... | 7,762.00..... | 35,932.00 |
| Powder River..... | 36,030.00..... | 2,578.00..... | 38,608.00 |
| Little Missouri River..... | 42,513.00..... | 1,499.00..... | 44,012.00 |
| Grand Total Missouri River Basin..... | 1,755,620.68..... | 390,690.62..... | 2,146,311.30 |
| Columbia River Drainage Basin | | | |
| Columbia River..... | 0.00..... | 0.00..... | 0.00 |
| Kootenai (Kootenay) River..... | 9,914.13..... | 968.00..... | 10,882.13 |
| Clark Fork (Deer Lodge) (Hellgate) | | | |
| (Missoula) River..... | 156,269.70..... | 17,293.20..... | 173,562.90 |
| Bitterroot River..... | 111,102.43..... | 3,200.00..... | 114,302.43 |
| Flathead River..... | 141,511.19..... | 5,135.22..... | 146,646.41 |
| Little Bitterroot River..... | 15,297.00..... | 337.00..... | 15,634.00 |
| Grand Total Columbia River Basin..... | 434,094.45..... | 26,933.42..... | 461,027.87 |
| GRAND TOTAL COUNTIES COMPLETED TO DATE..... | 2,190,328.13..... | 417,699.04..... | 2,608,027.17 |

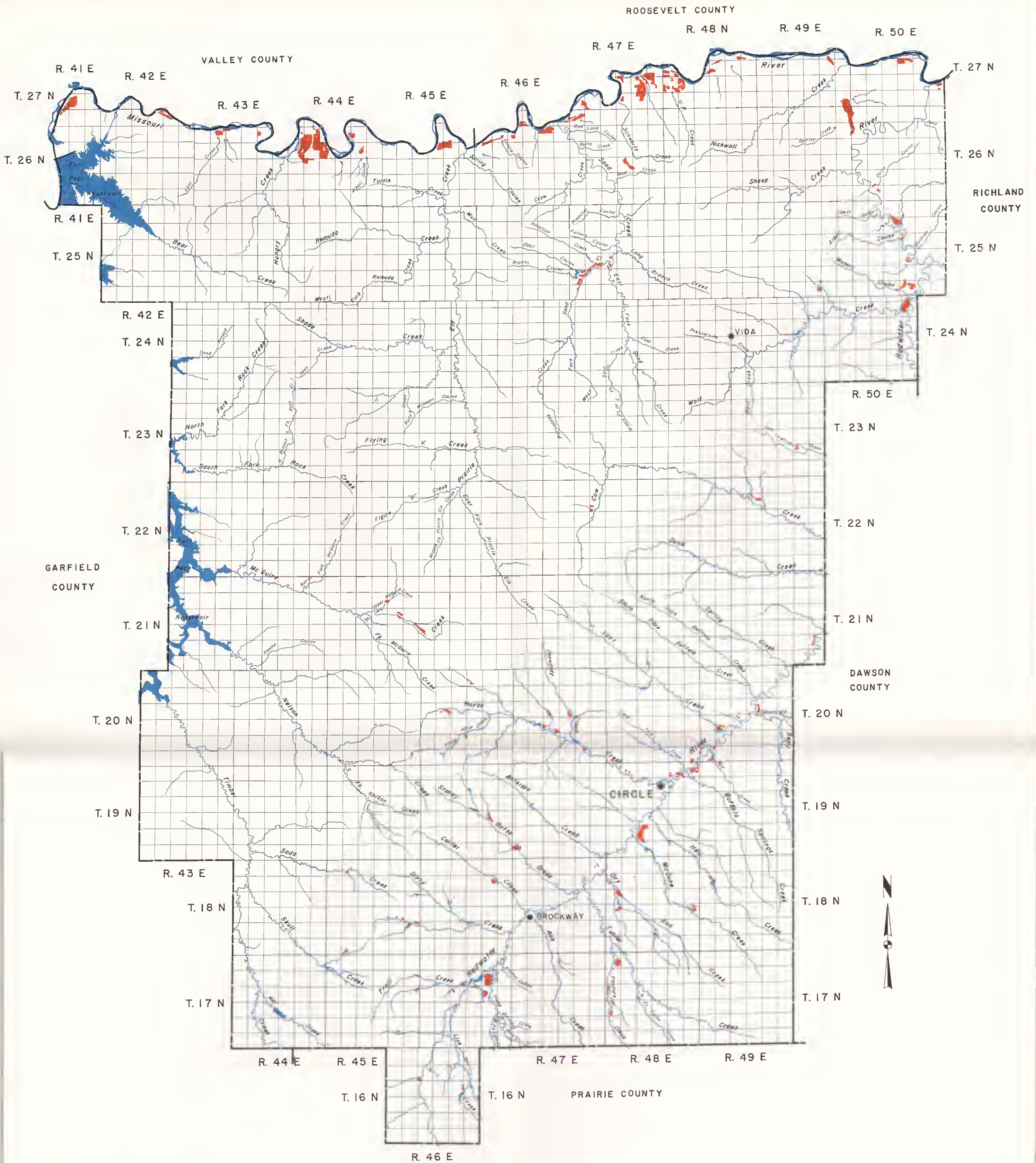
*Name of streams indented on the left-hand margin indicate that they are tributaries of the first stream named above which is not indented.

**Figures in these River Basins revised by resurvey of Carbon County, 1965

MAP INDEX

| Township | Range | Page | Township | Range | Page |
|----------|--------------|------|----------|--------------|------|
| 16 North | 46 East..... | T 1 | 22 North | 47 East..... | T 21 |
| 17 North | 45 East..... | T 2 | 22 North | 49 East..... | T 22 |
| 17 North | 46 East..... | T 3 | 23 North | 46 East..... | T 23 |
| 17 North | 47 East..... | T 4 | 23 North | 49 East..... | T 24 |
| 17 North | 48 East..... | T 5 | 24 North | 47 East..... | T 25 |
| 18 North | 45 East..... | T 6 | 24 North | 50 East..... | T 26 |
| 18 North | 46 East..... | T 7 | 25 North | 47 East..... | T 27 |
| 18 North | 47 East..... | T 8 | 25 North | 49 East..... | T 28 |
| 18 North | 48 East..... | T 9 | 25 North | 50 East..... | T 29 |
| 18 North | 49 East..... | T 9 | 26 North | 41 East..... | T 30 |
| 19 North | 45 East..... | T 10 | 26 North | 42 East..... | T 31 |
| 19 North | 46 East..... | T 11 | 26 North | 43 East..... | T 32 |
| 19 North | 47 East..... | T 12 | 26 North | 44 East..... | T 33 |
| 19 North | 48 East..... | T 13 | 26 North | 45 East..... | T 34 |
| 19 North | 49 East..... | T 13 | 26 North | 46 East..... | T 35 |
| 20 North | 45 East..... | T 14 | 26 North | 47 East..... | T 36 |
| 20 North | 46 East..... | T 15 | 26 North | 49 East..... | T 37 |
| 20 North | 47 East..... | T 16 | 26 North | 50 East..... | T 38 |
| 20 North | 48 East..... | T 13 | 27 North | 41 East..... | T 30 |
| 20 North | 49 East..... | T 17 | 27 North | 42 East..... | T 31 |
| 21 North | 45 East..... | T 18 | 27 North | 47 East..... | T 39 |
| 21 North | 47 East..... | T 19 | 27 North | 48 East..... | T 40 |
| 21 North | 48 East..... | T 19 | 27 North | 49 East..... | T 41 |
| 21 North | 49 East..... | T 20 | 27 North | 50 East..... | T 42 |

All maps have been made from aerial photographs



MONTANA WATER RESOURCES BOARD

DRAINAGE MAP
SHOWING IRRIGATED AREAS
McCONE COUNTY
 COMPILED FROM DATA AVAILABLE AS OF
 JULY 1971

Compiled from Aerial Photographs, Water Right Data,
 Government Land Office Surveys and Field Investigations.

Drafted by: Juna Virag & James Sharkey

2 Mi. 8 Mi.

MAP SYMBOL INDEX

BOUNDARIES

- INTERNATIONAL
- STATE
- COUNTY
- NATIONAL FOREST

DITCHES

- CANALS OR DITCHES
- DRAIN DITCHES

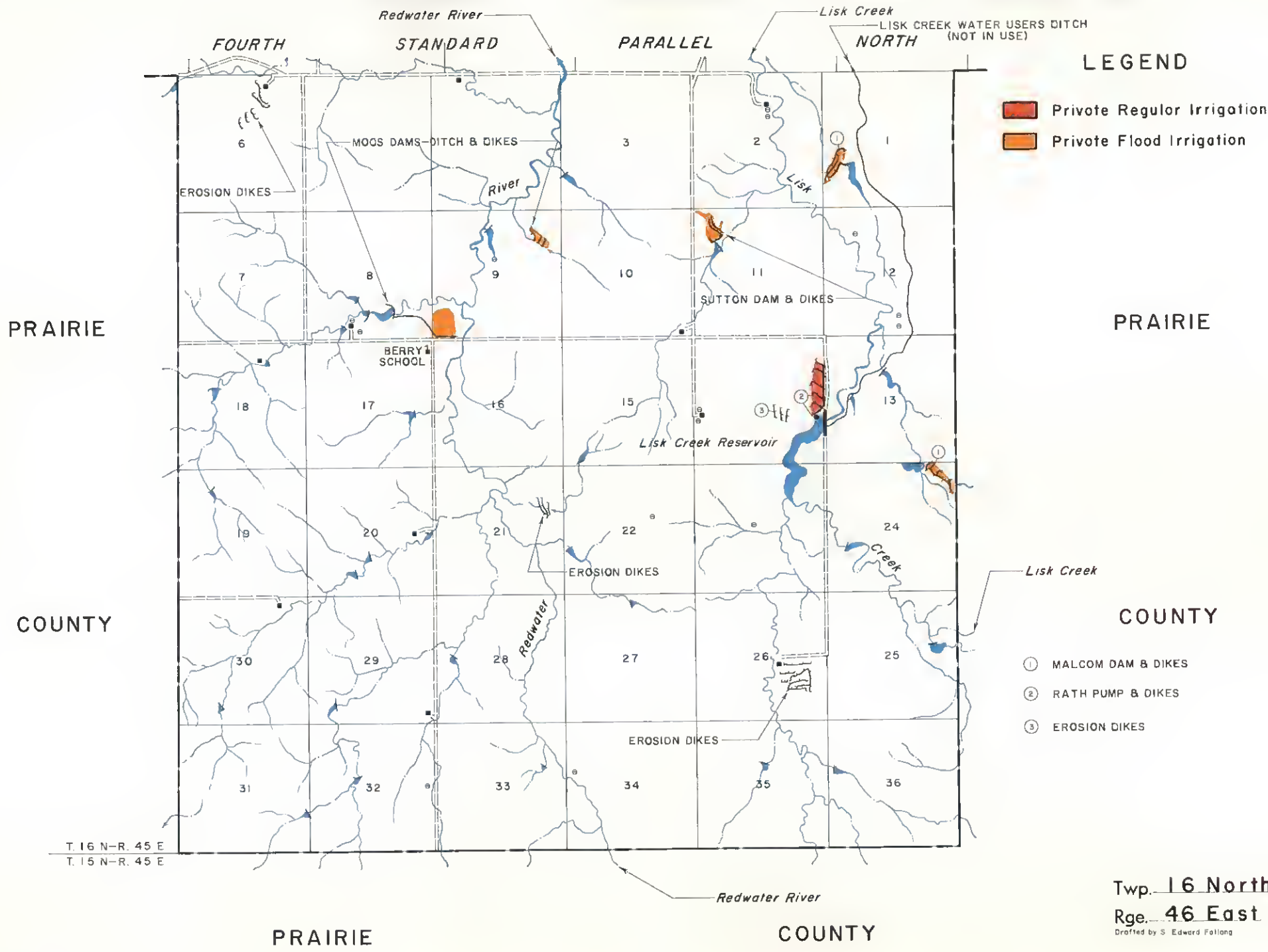
STRUCTURES & UNITS

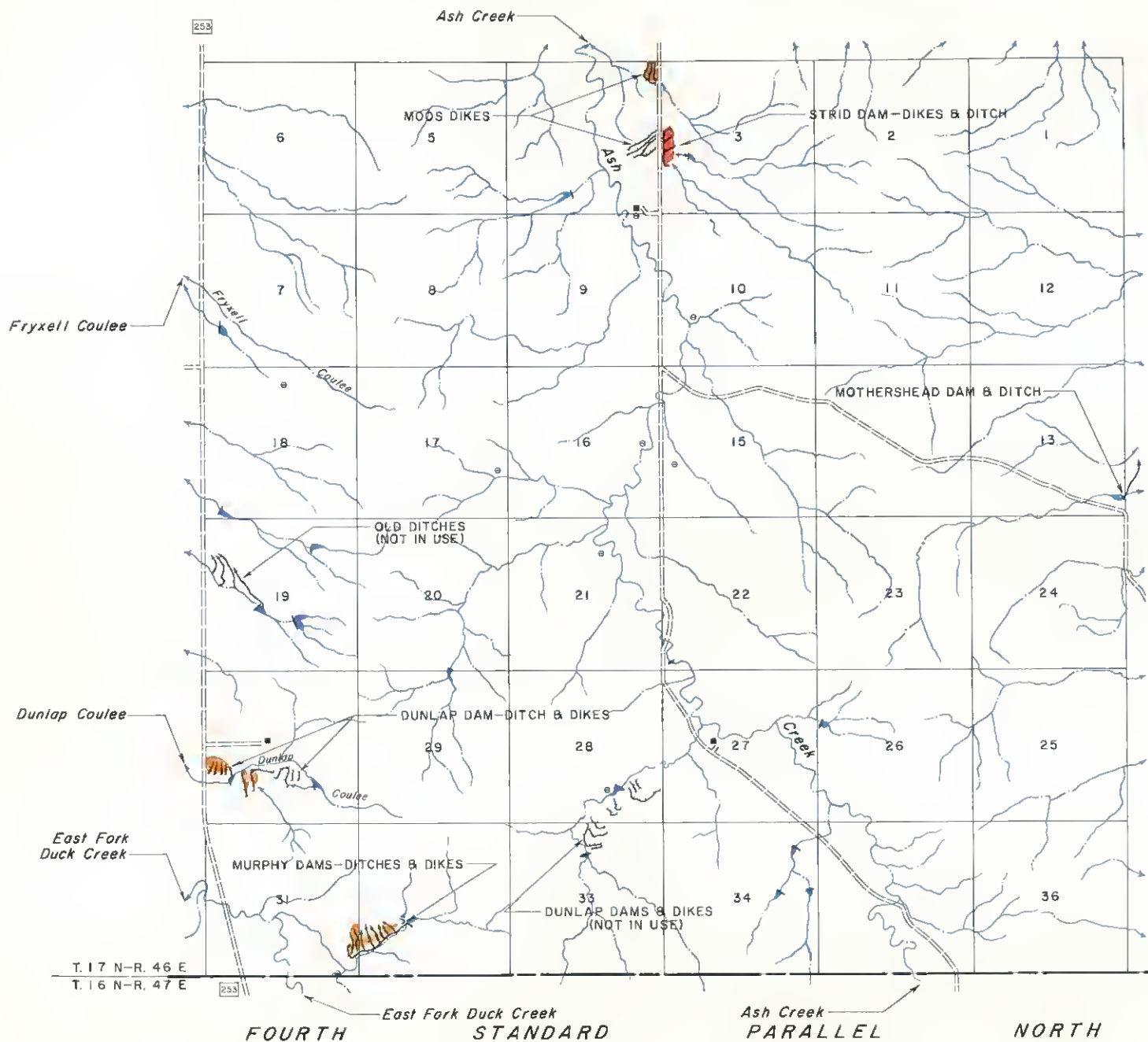
- / DAM
- E DIKE
- FLUME
- SIPHON
- SPILL
- SPRINKLER SYSTEM
- WEIR
- PIPE LINE
- PUMP
- PUMP SITE
- ⊖ WELL
- ⊕ ARTESIAN WELL
- +++ NATURAL CARRIER USED AS DITCH
- * SPRING
- RESERVOIR

TRANSPORTATION

- == PAVED ROADS
- === UNPAVED ROADS
- ++++ RAILROADS
- 10 STATE HIGHWAY
- 89 U.S. HIGHWAY
- 25 INTERSTATE HIGHWAY
- ◇ AIRPORT
- ✈ LANDING STRIP

- ⬇ SWAMP
- ⊗ GAUGING STATION
- ☒ POWER PLANT
- ⊗ STORAGE TANK
- ⊠ CEMETERY
- ⊙ FAIRGROUNDS
- FARM OR RANCH UNIT
- 1 SCHOOL
- 🏠 LOOKOUT STATION
- 🏠 RANGER STATION
- BRIDGE
- - - RAILROAD TUNNEL
- X REST AREA
- X SHAFT, MINE, OR GRAVEL PIT
- ⚡ OIL WELL OR OIL FIELD

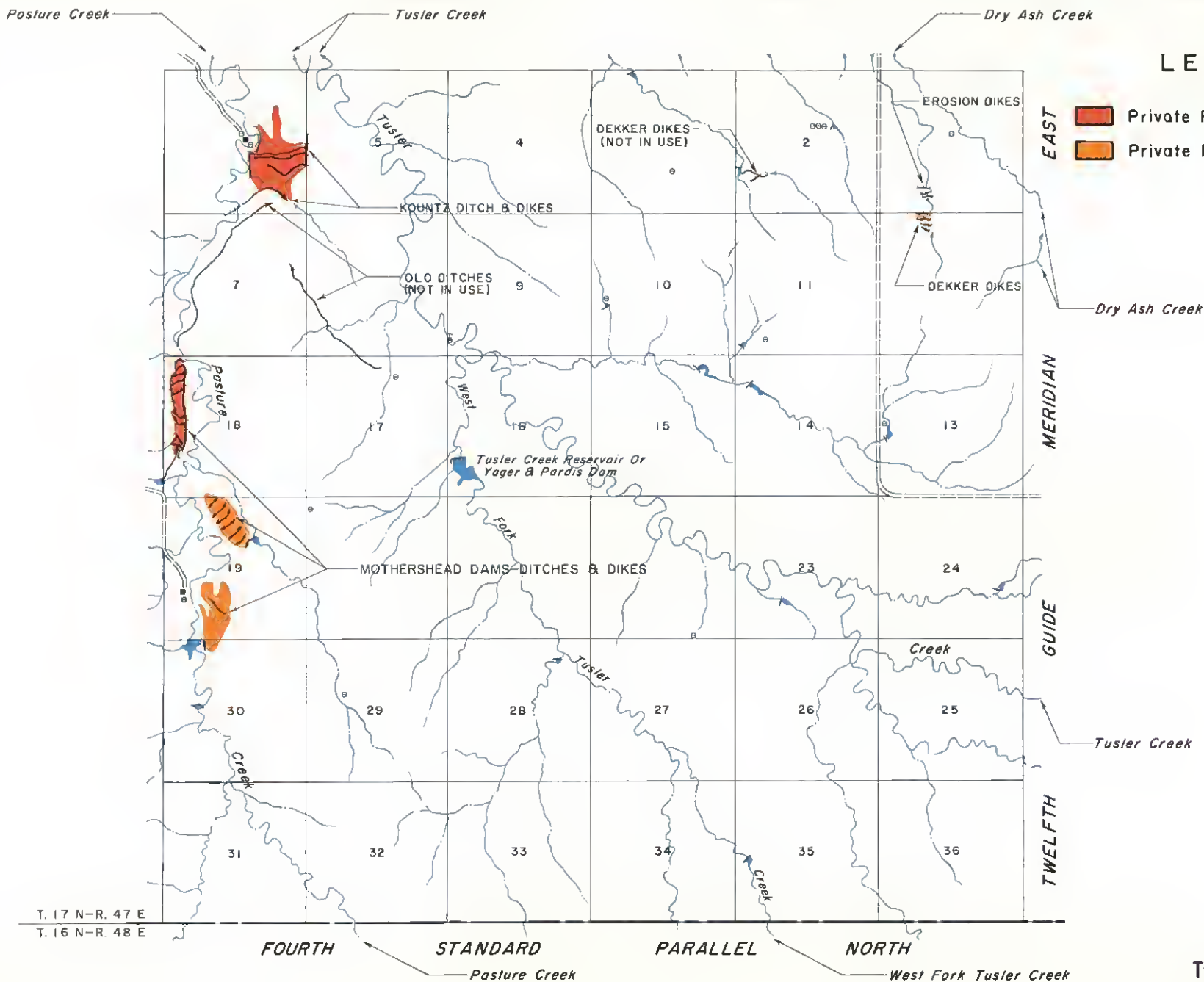




LEGEND

- Private Regular Irrigation
- Private Flood Irrigation

Twp. 17 North
Rge. 47 East
Drafted by S. Edward Follong



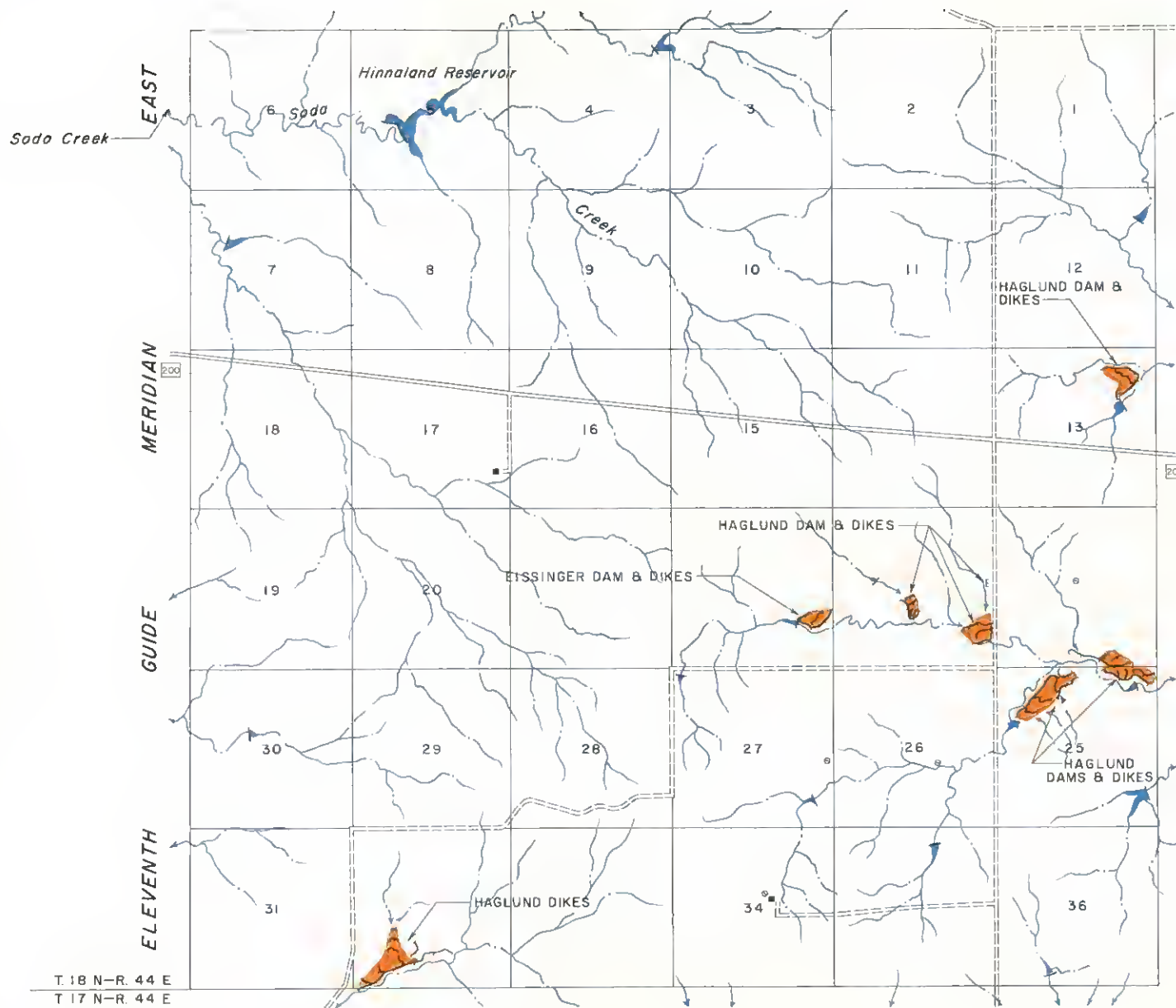
PRAIRIE

COUNTY

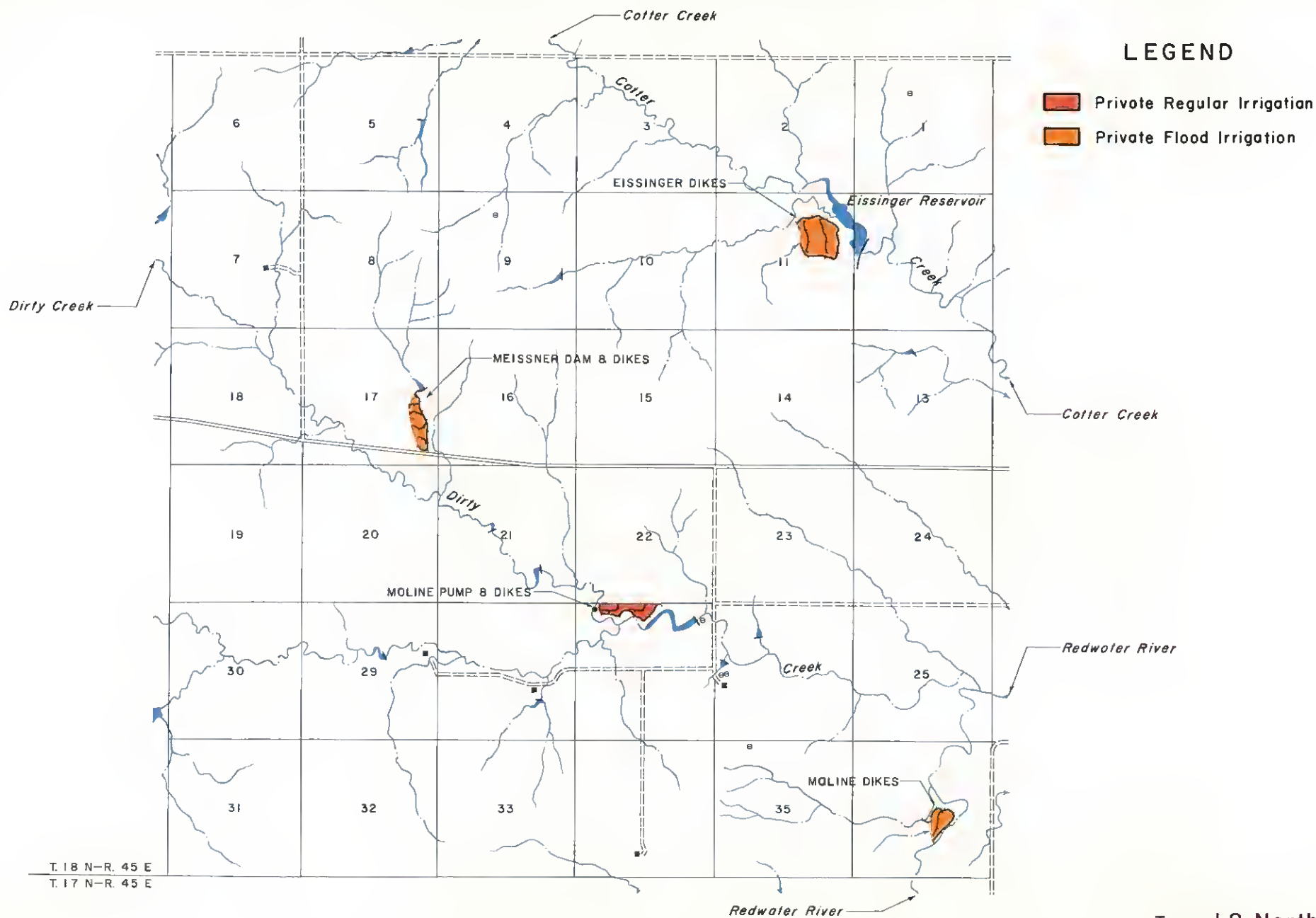
Twp. 17 North

Rge. 48 East

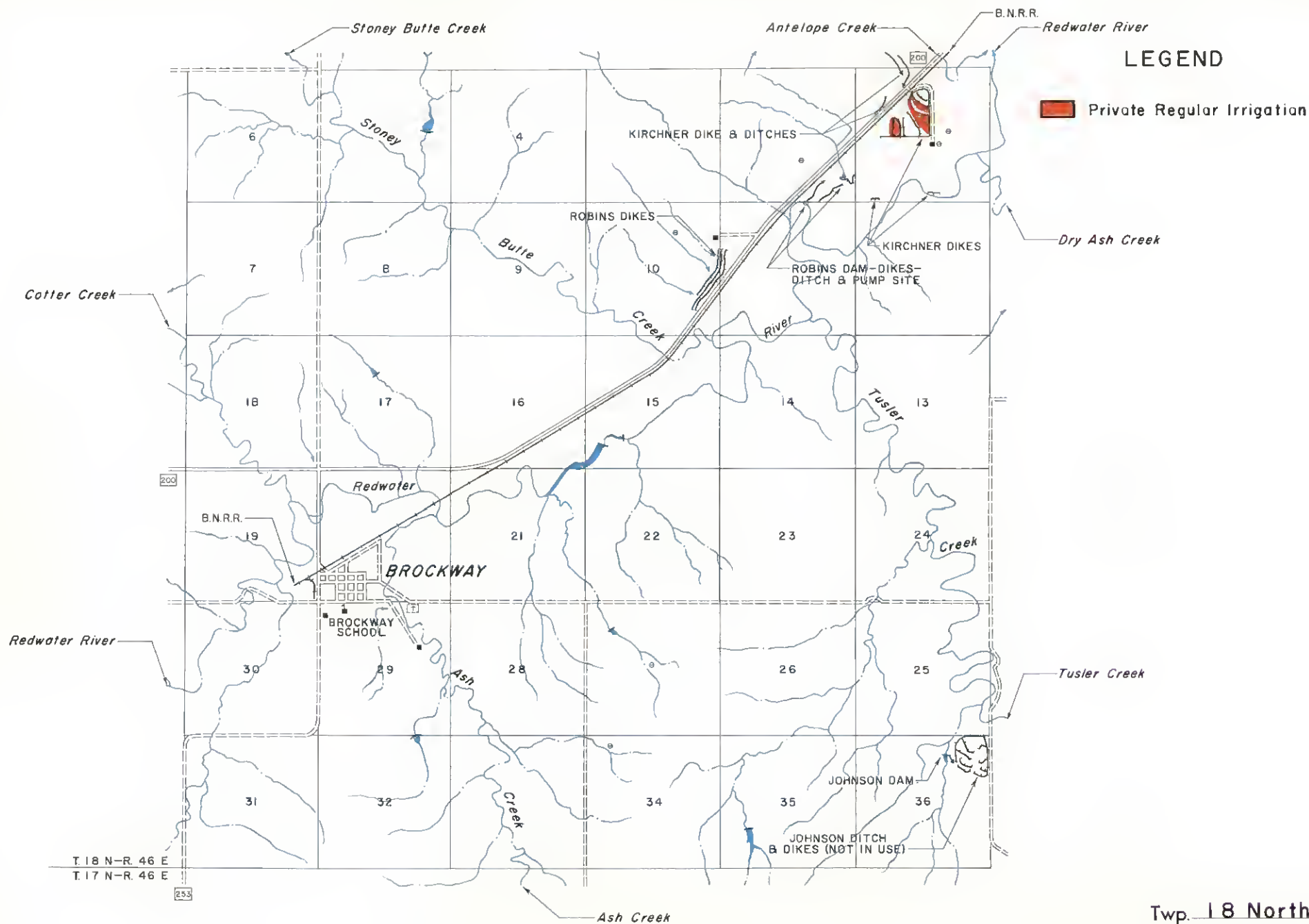
Drafted by S. Edward Follong



Twp. 18 North
 Rge. 45 East
Drafted by S. Edward Follong



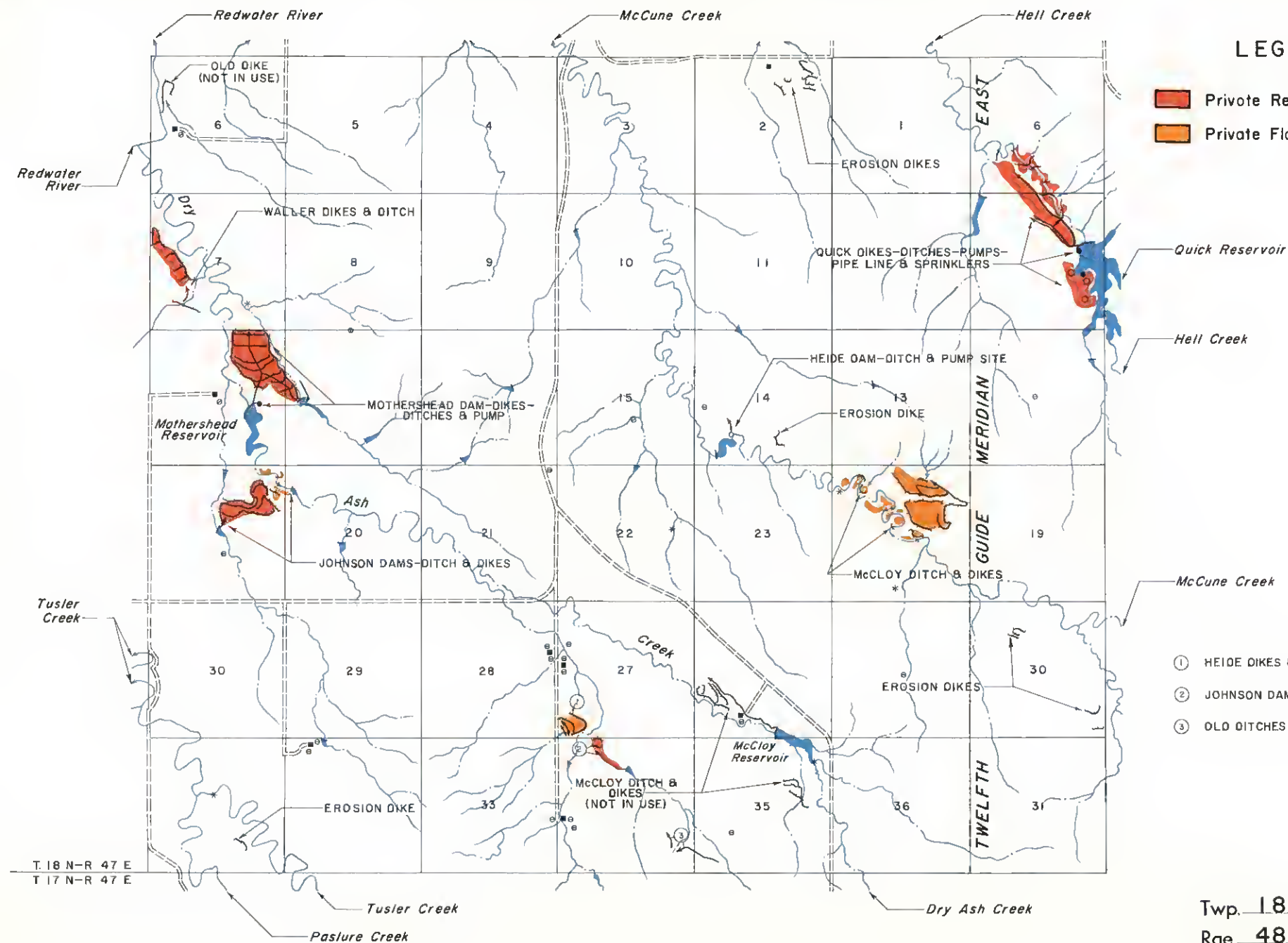
Twp. 18 North
 Rge. 46 East
 Drafted by S. Edward Fallang



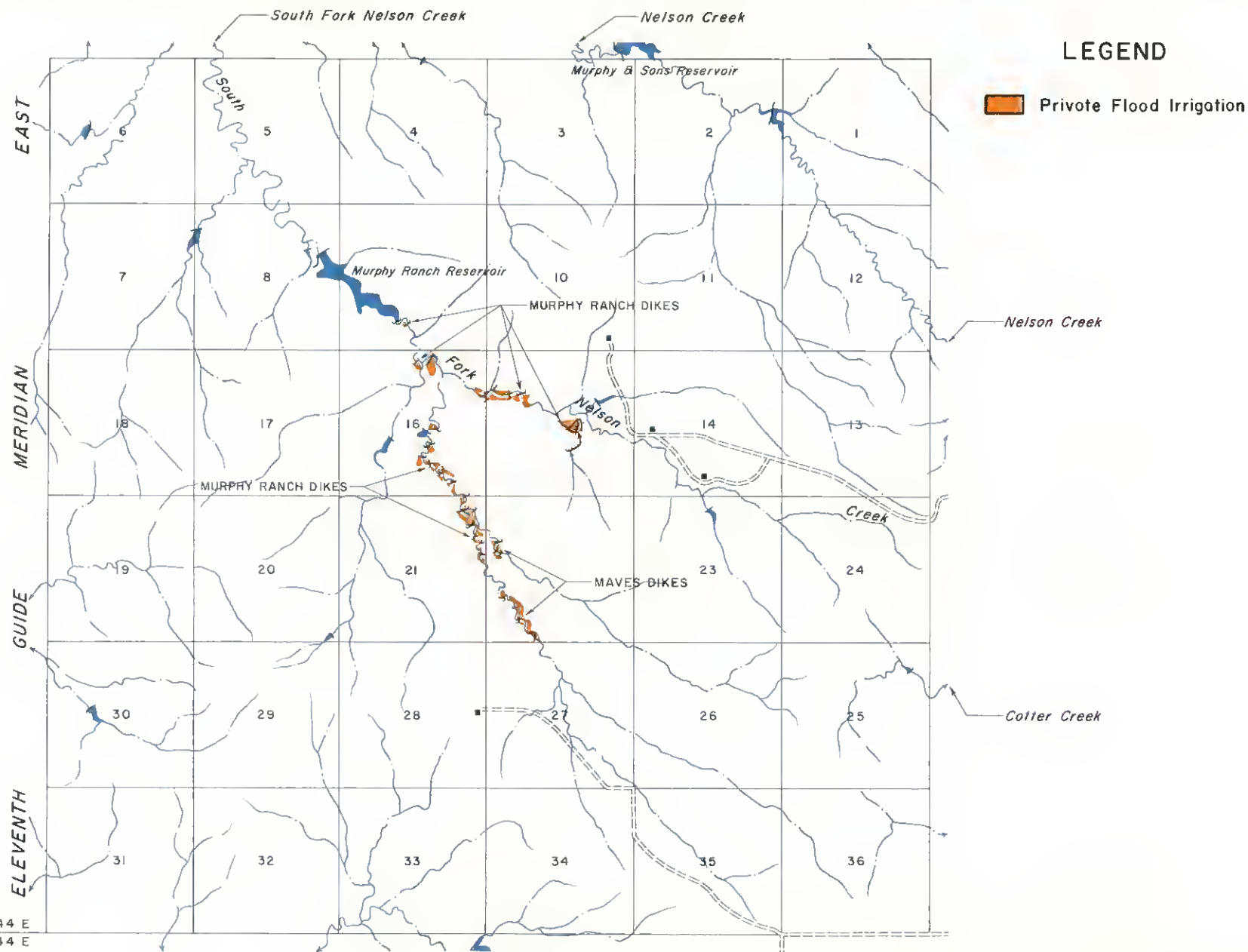
LEGEND

- Private Regular Irrigation
- Private Flood Irrigation

- ① HEIDE DIKES & DITCHES
- ② JOHNSON DAM-DITCH & DIKES
- ③ OLD DITCHES (NOT IN USE)



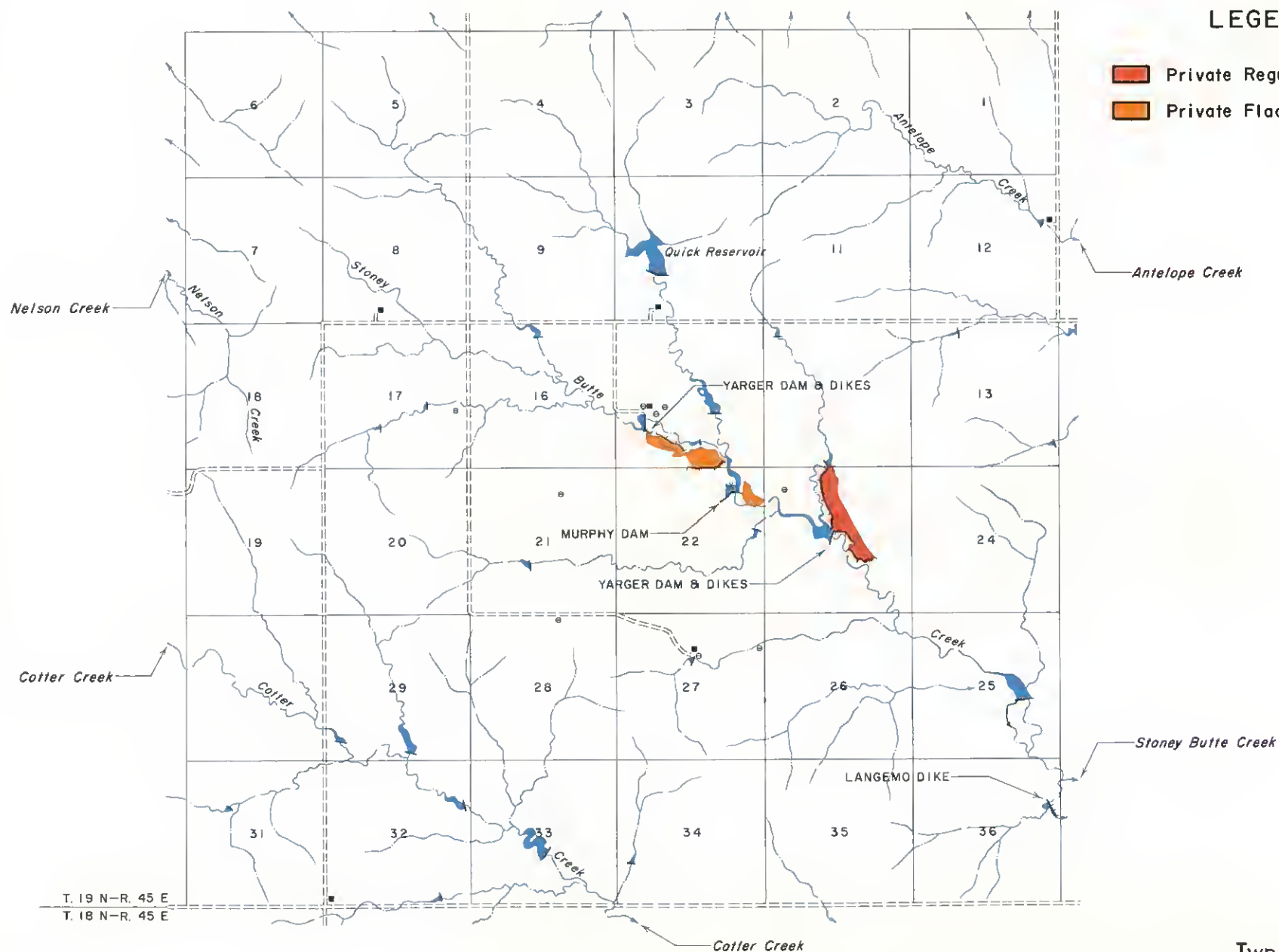
Twp. 18 North
Rge. 48 & 49 East
Drafted by S. Edward Fallang



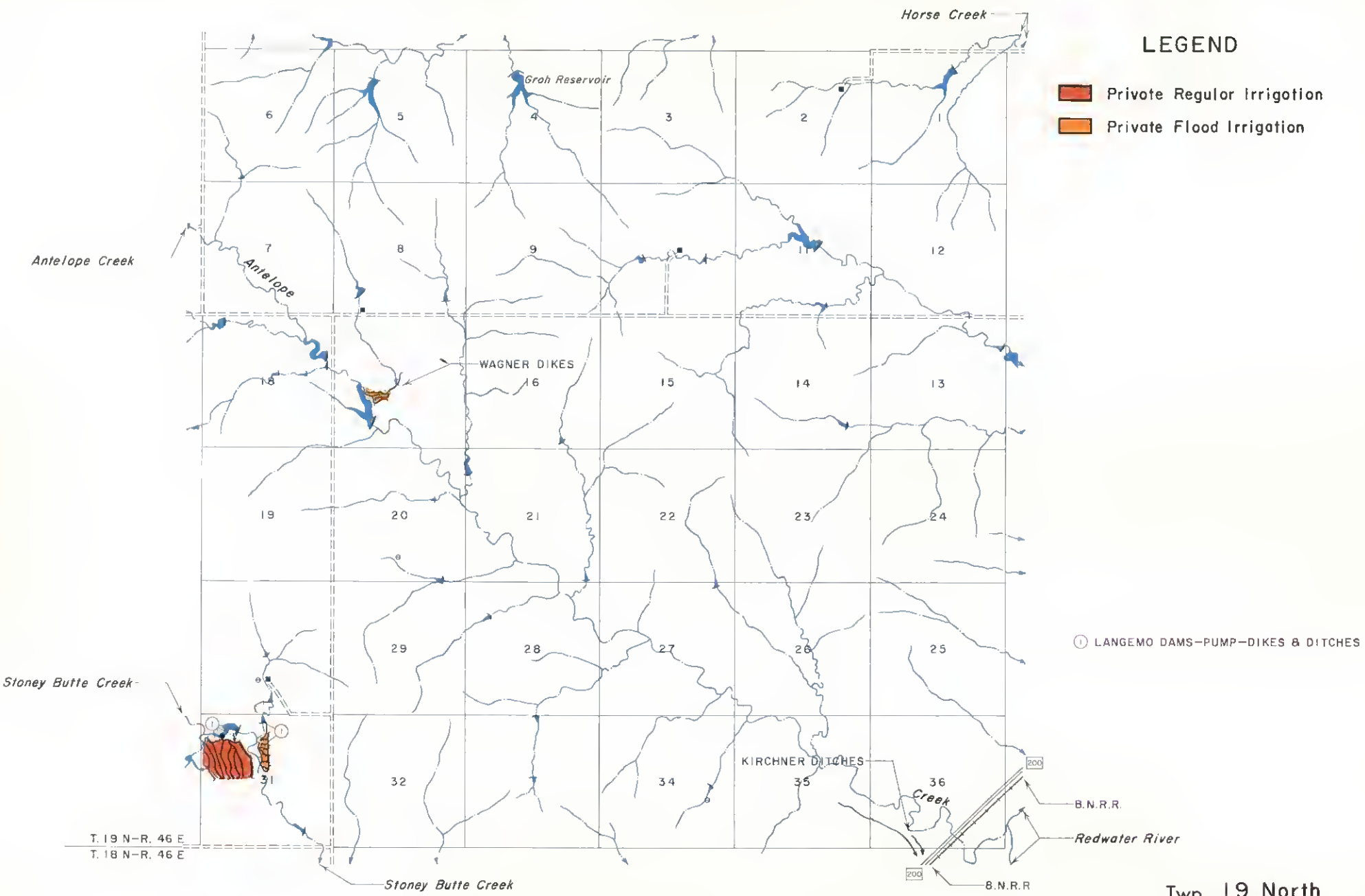
Twp. 19 North
Rge. 45 East
Drafted by S. Edward Failing

LEGEND

- Private Regular Irrigation
- Private Flood Irrigation



Twp. 19 North
Rge. 46 East
Drafted by Don Nelson



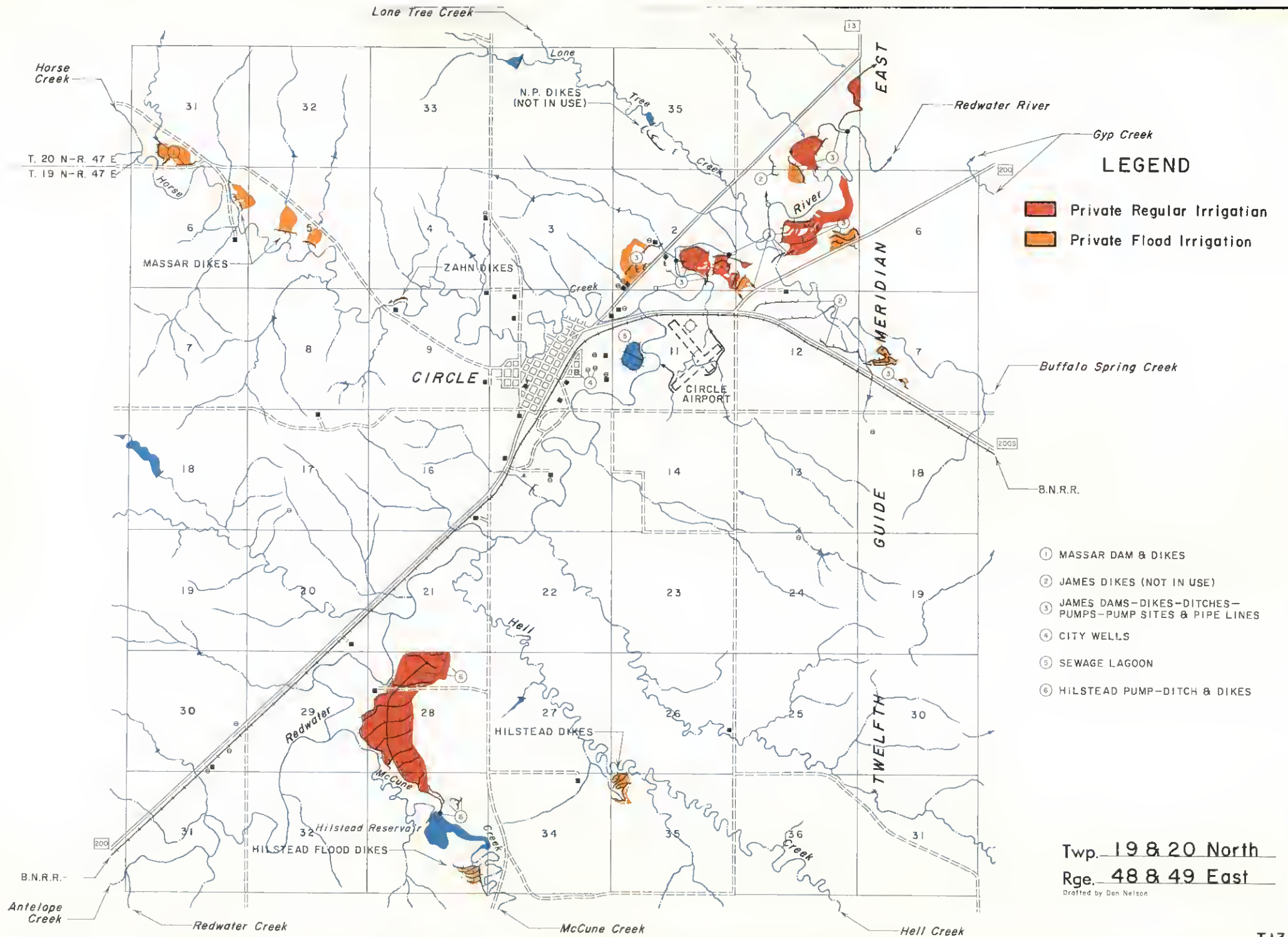
LEGEND

- Private Regular Irrigation
- Private Flood Irrigation

① LANGEMO DAMS-PUMP-DIKES & DITCHES

Twp. 19 North
Rge. 47 East

Drafted by Dan Nelson



Twp. 19 & 20 North
 Rge. 48 & 49 East
 Drafted by Dan Nelson

FIFTH

STANDARD

PARALLEL

NORTH

South Fork McGuire Creek

LEGEND

-  Private Regular Irrigation
-  Private Flood Irrigation

South Fork McGuire Creek

Horse Creek

Nelson Creek

T. 20 N-R. 44 E
T. 19 N-R. 44 E

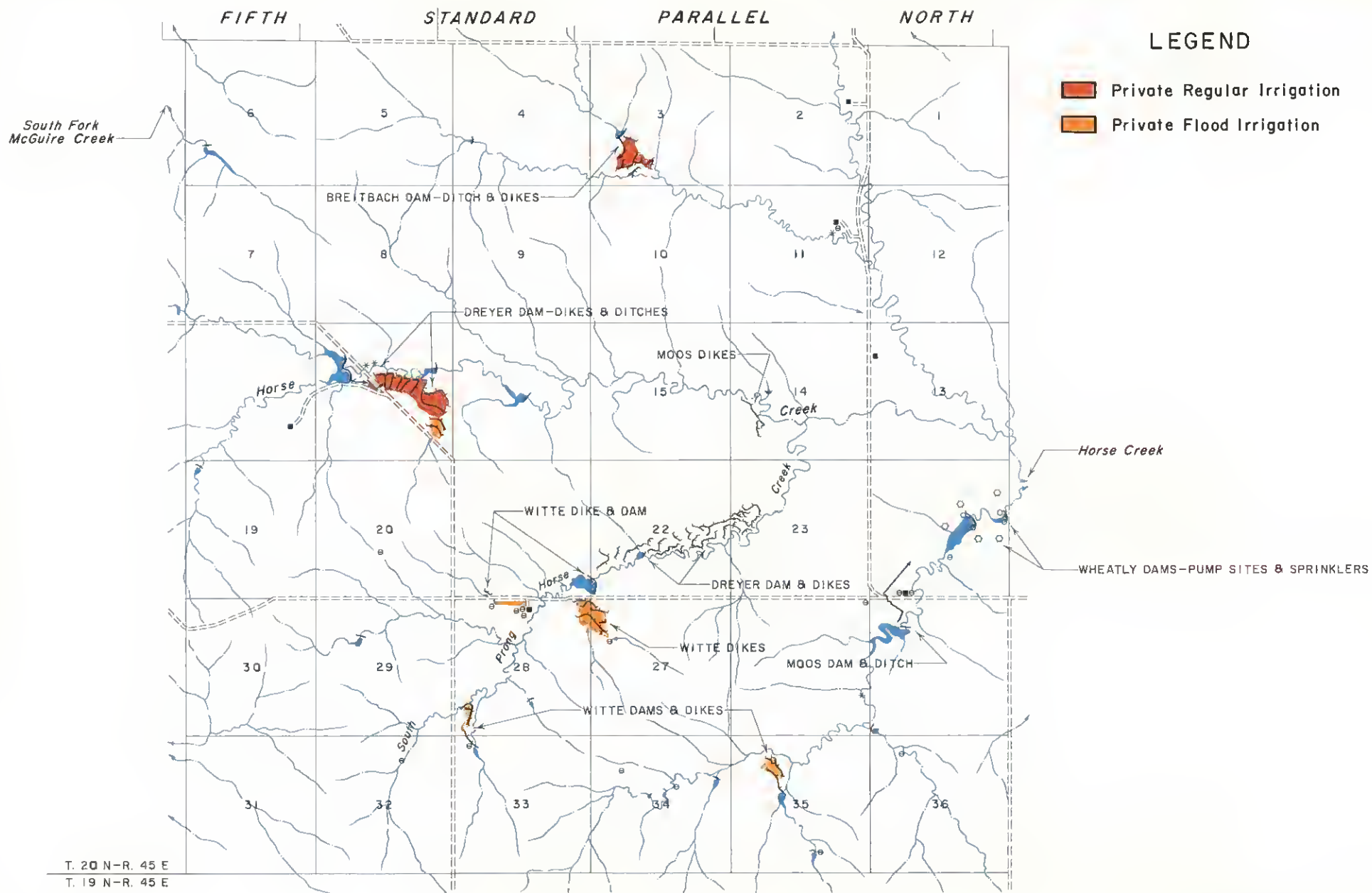
South Fork Nelson Creek

Nelson Creek

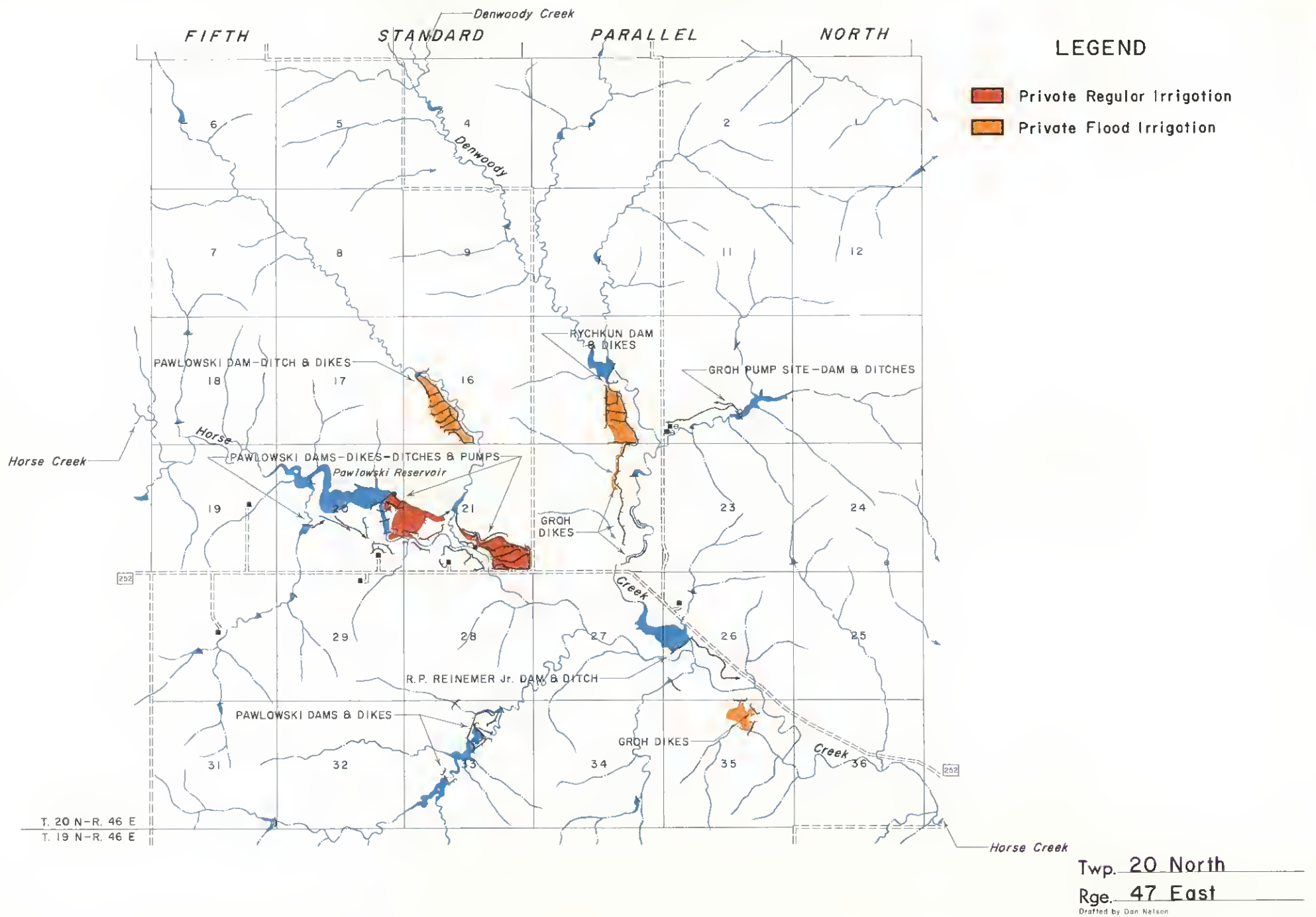
Twp. 20 North

Rge. 45 East

Drafted by Don Nelson



Twp. 20 North _____
Rge. 46 East _____
Drafted by Dan Nelson



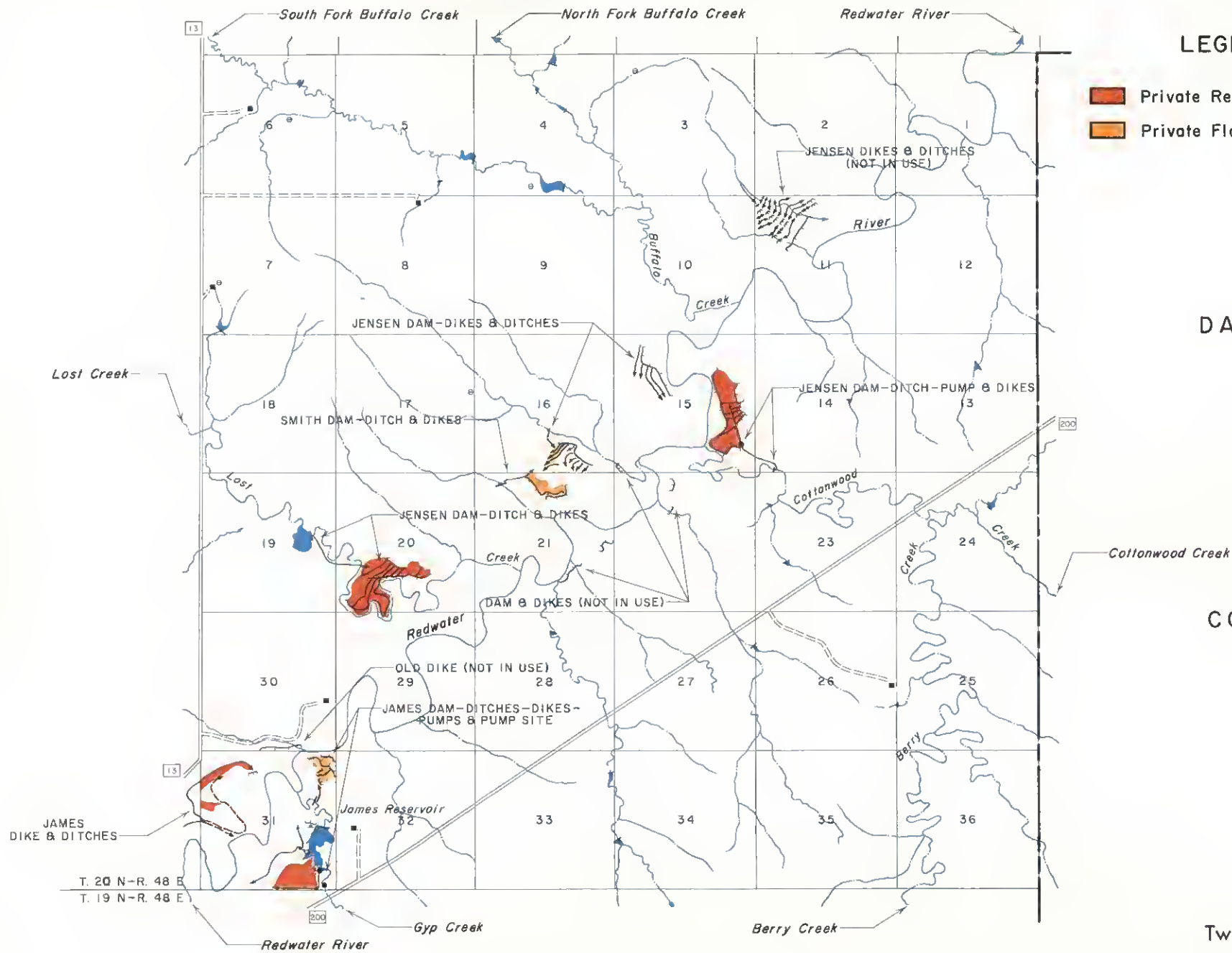
FIFTH STANDARD PARALLEL NORTH

LEGEND

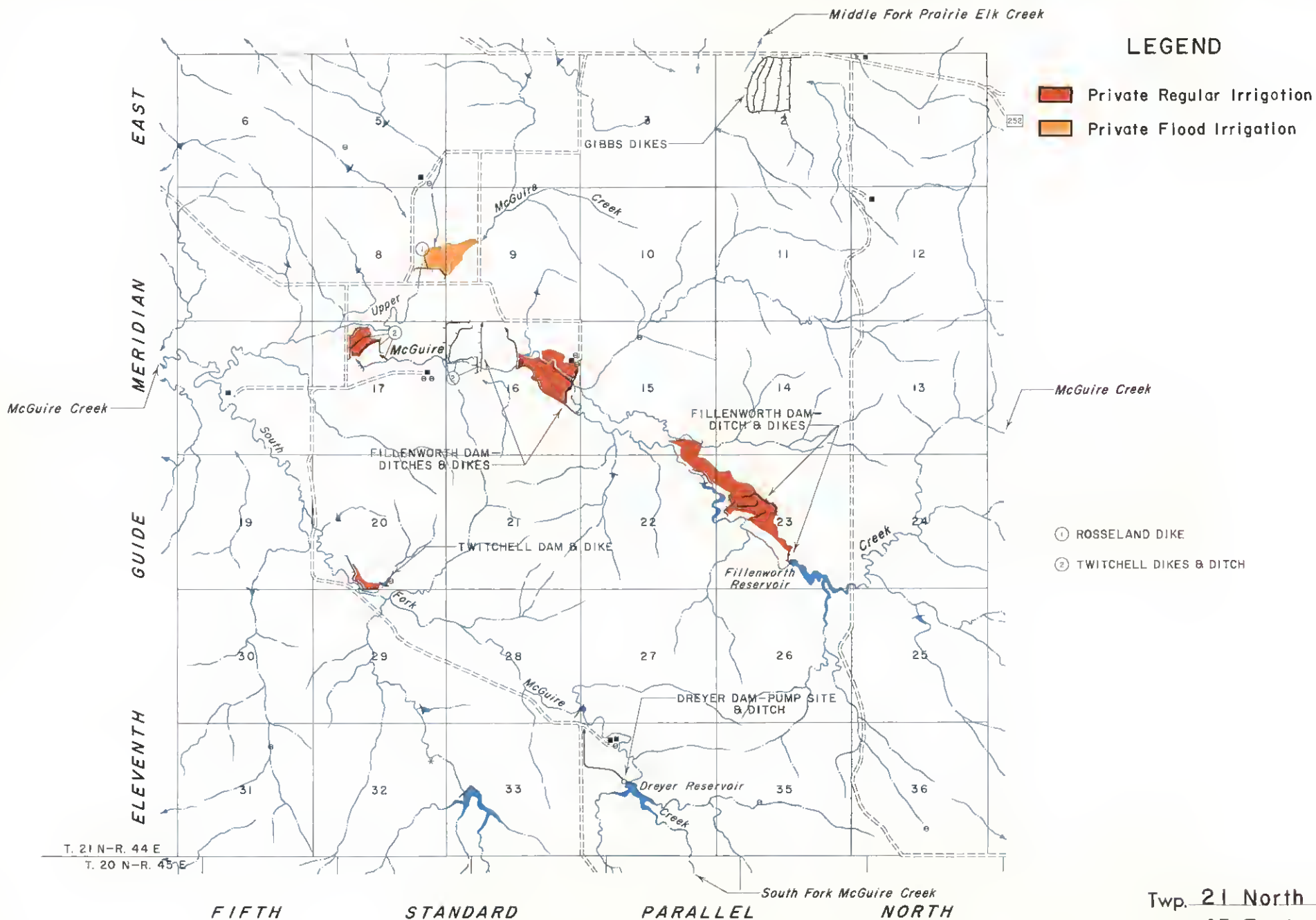
- Private Regular Irrigation
- Private Flood Irrigation

DAWSON

COUNTY

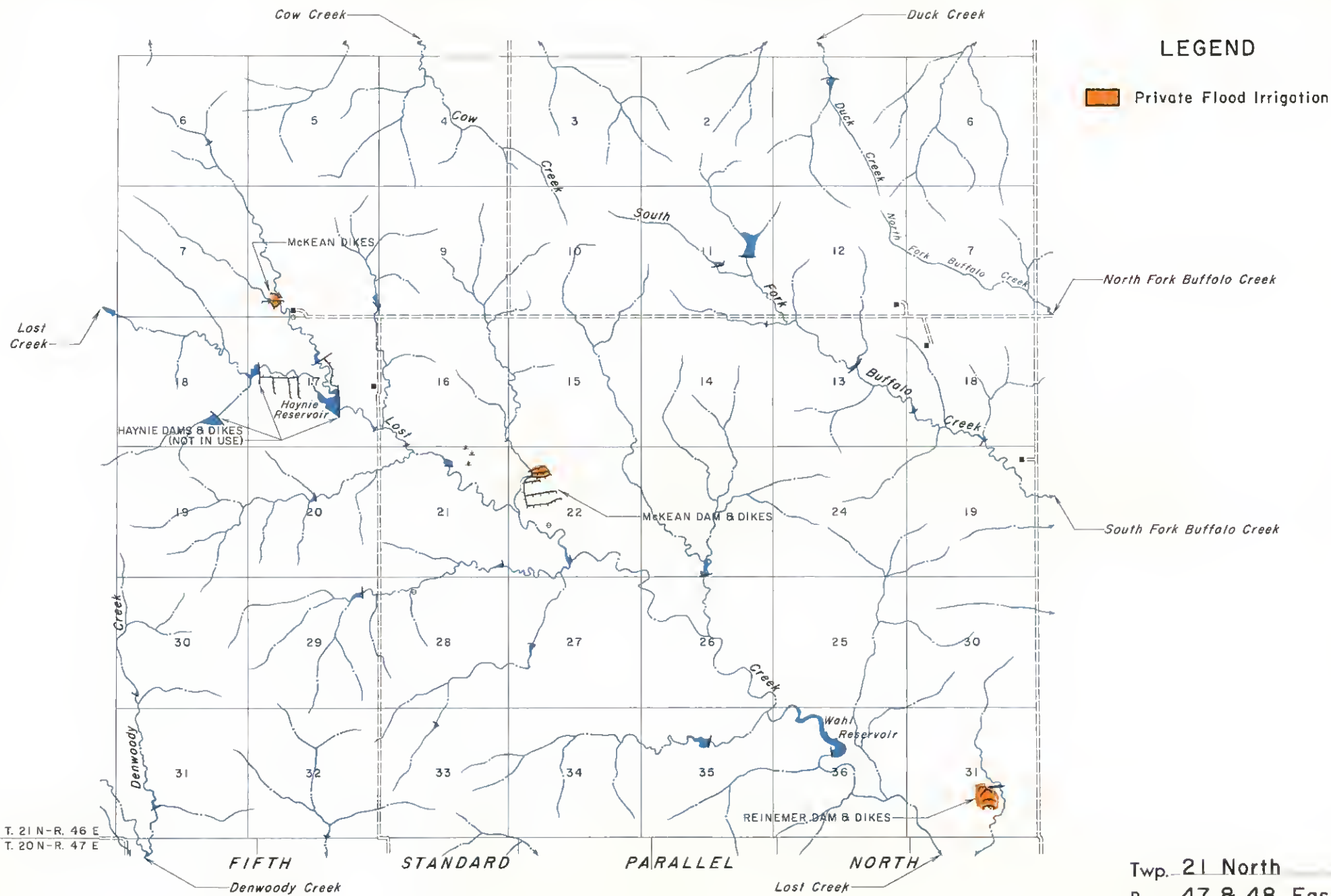


Twp. 20 North
Rge. 49 East
Drafted by Dan Nelson

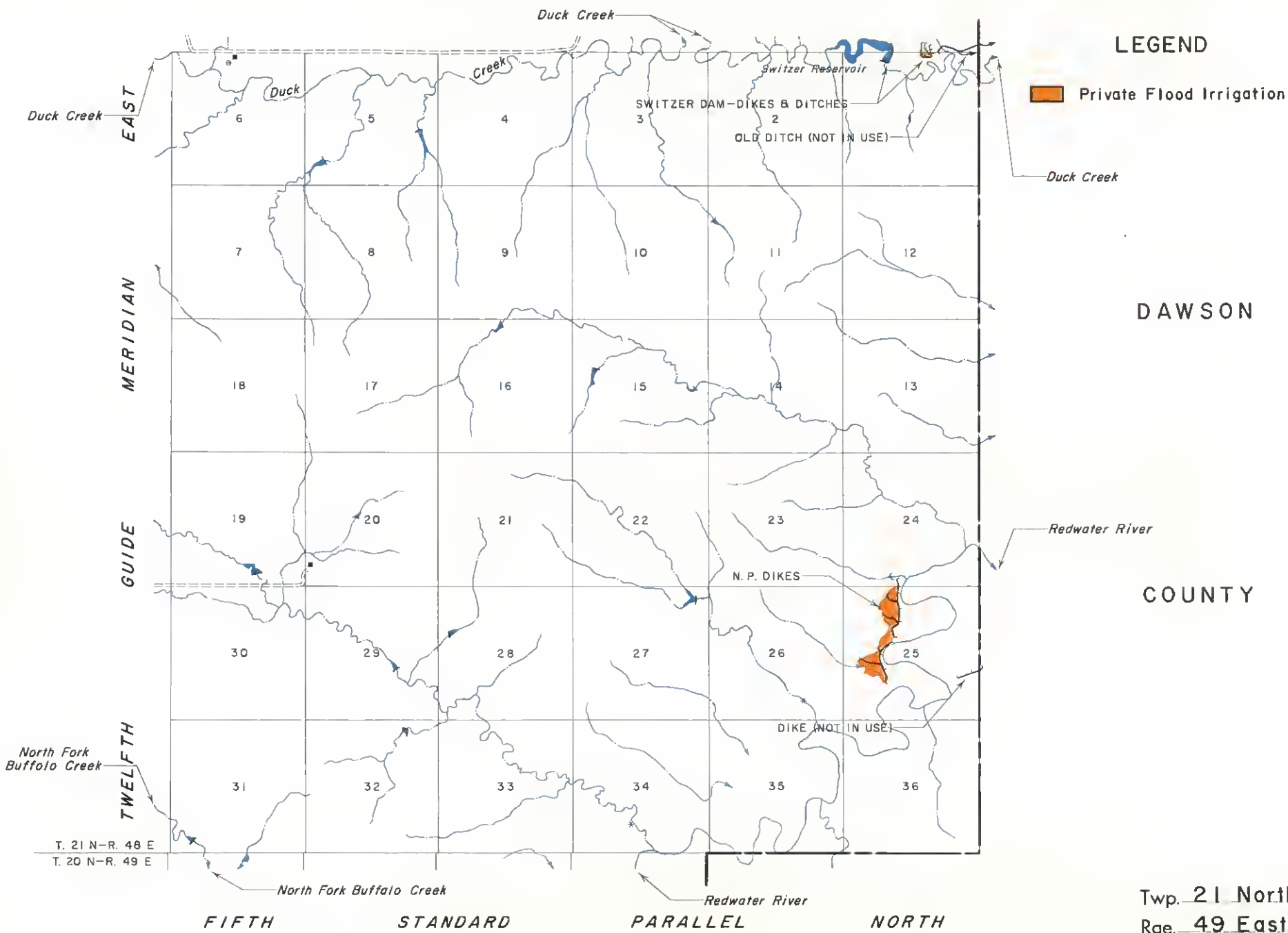


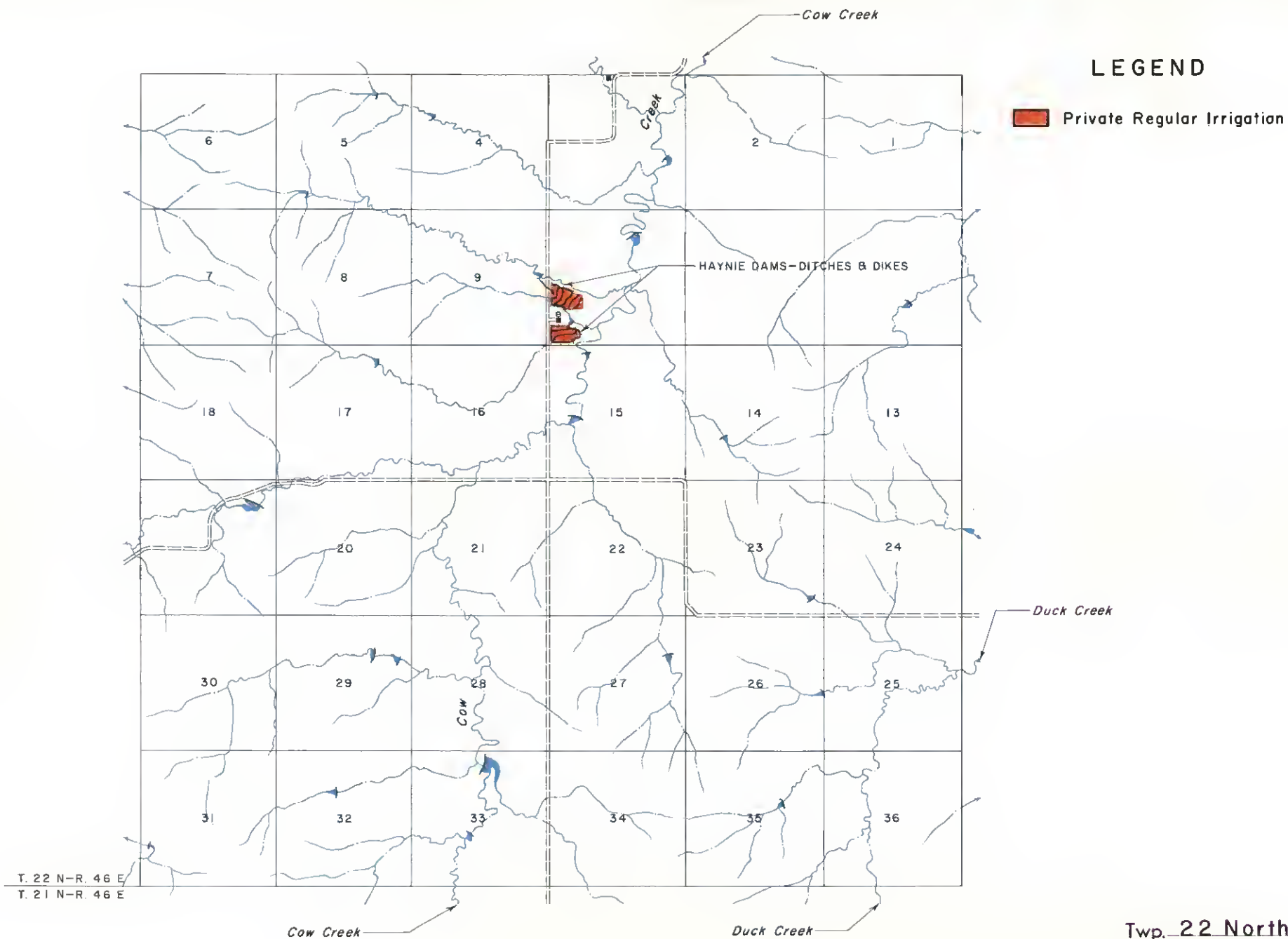
Twp. 21 North
Rge. 45 East

Drafted by Dan Nelson

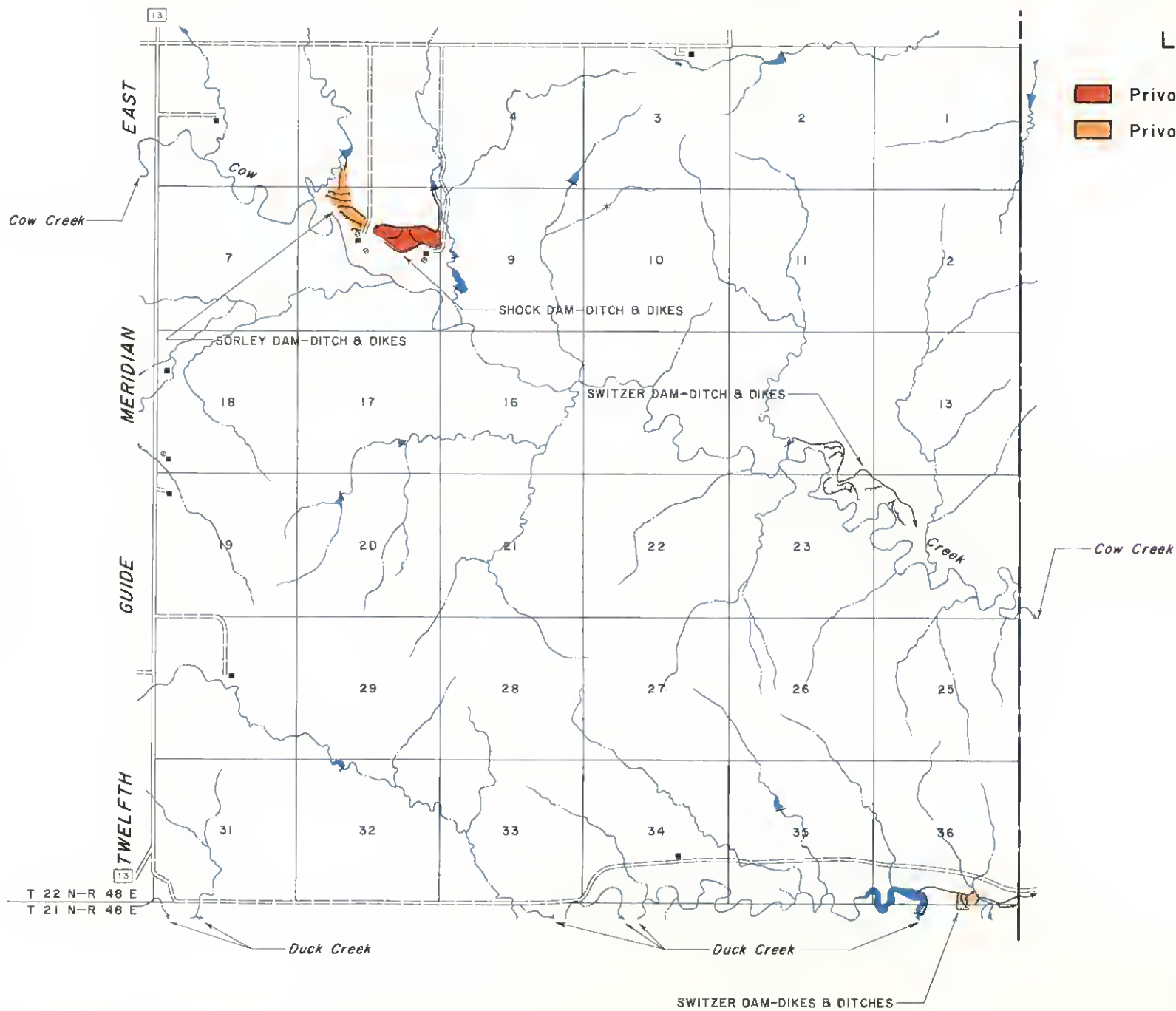


Twp. 21 North
Rge. 47 & 48 East
Drafted by Hugh D. Greenup

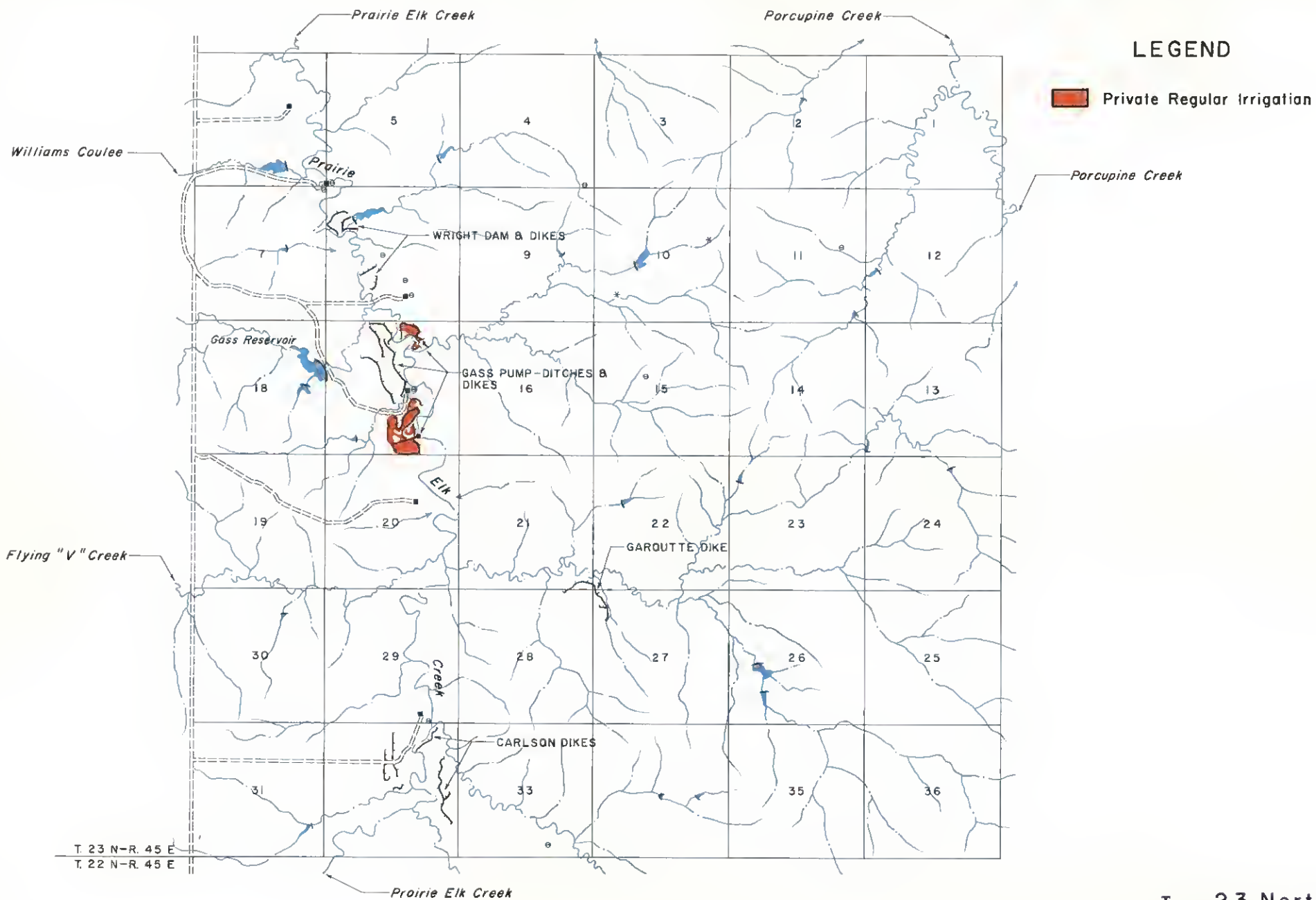




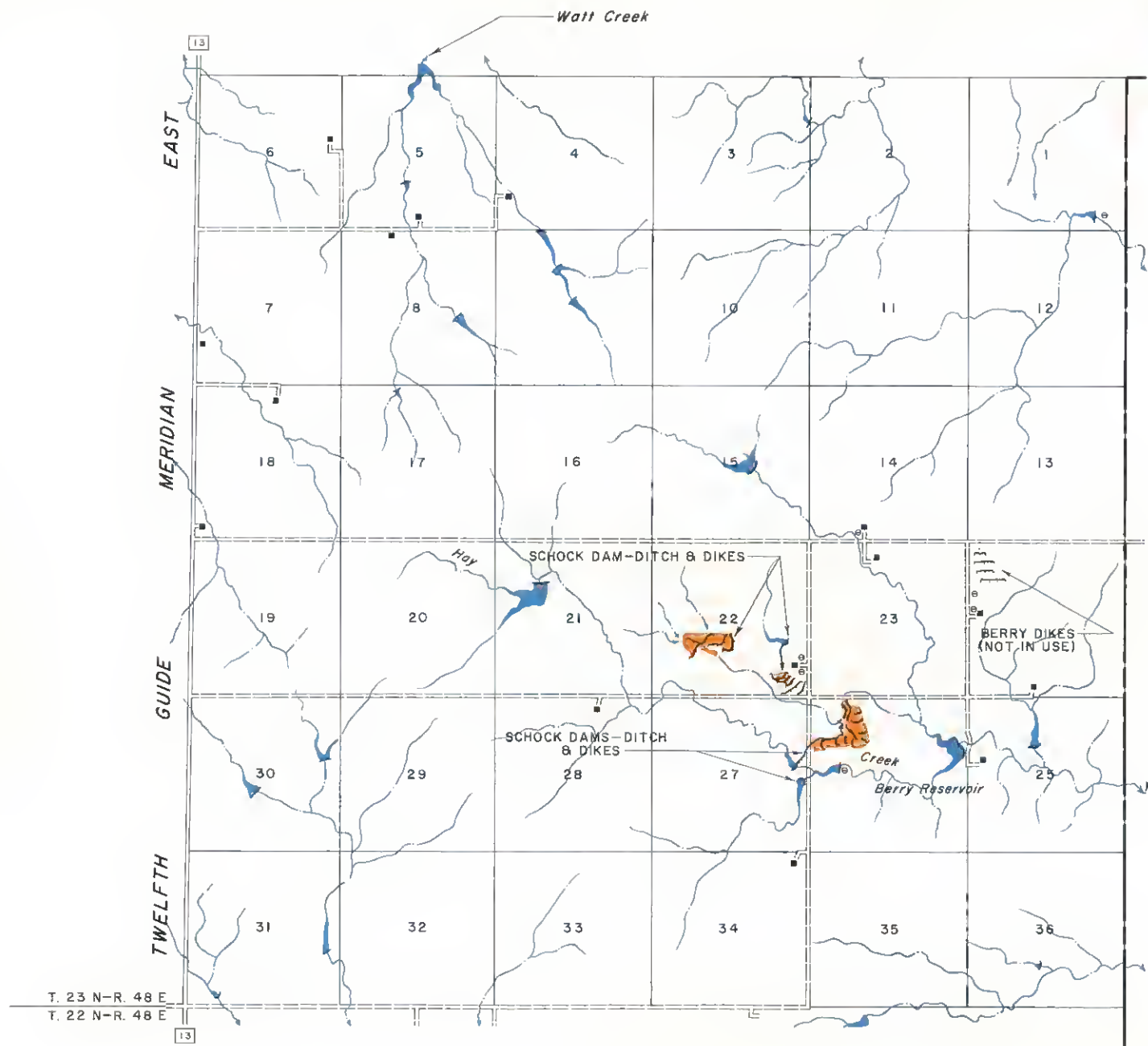
Twp. 22 North
Rge. 47 East
Drafted by S. Edward Fallang



Twp. 22 North
 Rge. 49 East
Drafted by S. Edward Fallang



Twp. 23 North
Rge. 46 East
Drafted by S. Edward Follong



LEGEND

 Private Flood Irrigation

DAWSON

COUNTY

Twp. 23 North _____

Rge. 49 East _____

Drafted by S. Edward Fallang

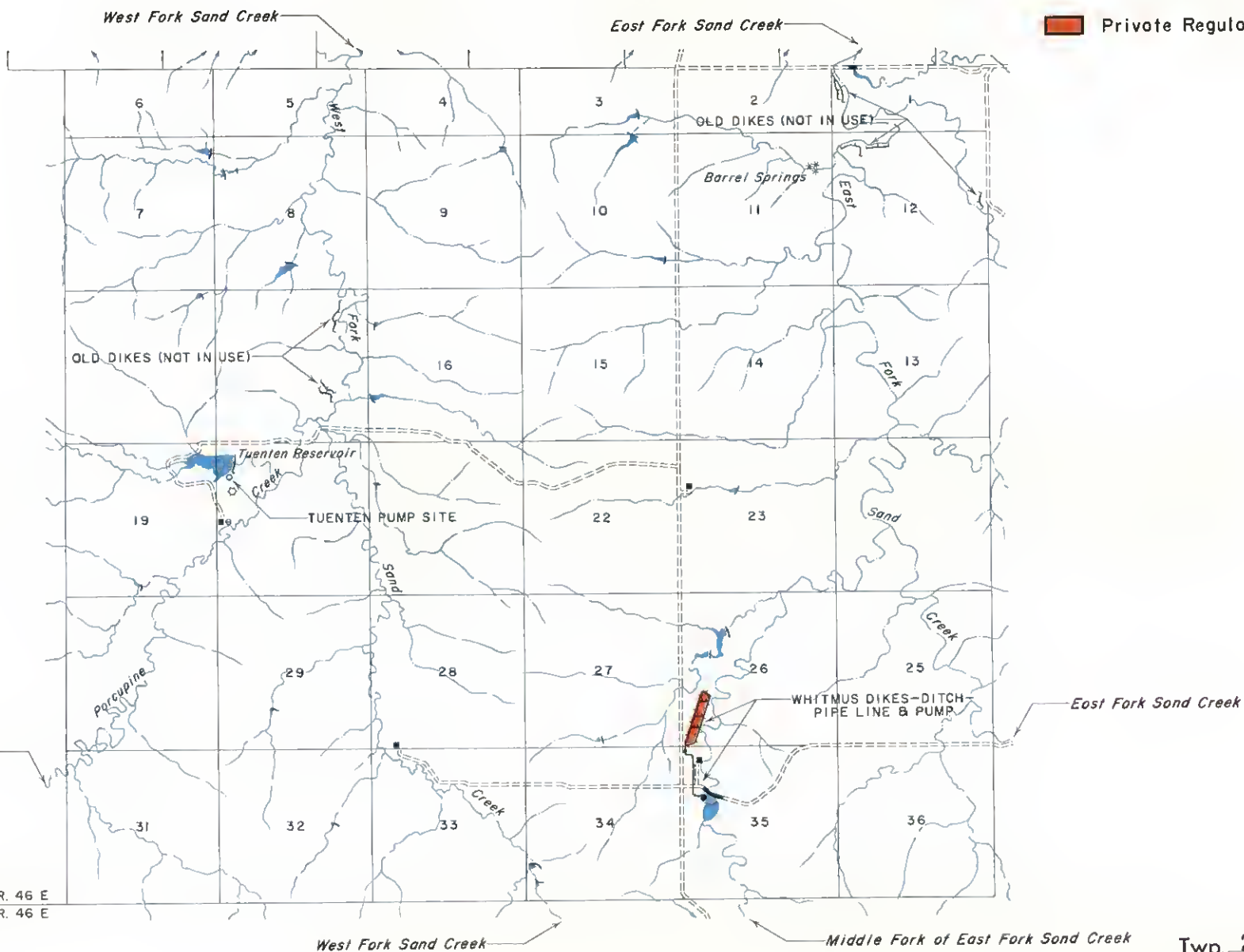
SIXTH

STANDARD

PARALLEL

NORTH

LEGEND

 Private Regular Irrigation


T. 24 N-R. 46 E
T. 23 N-R. 46 E

Twp. 24 North

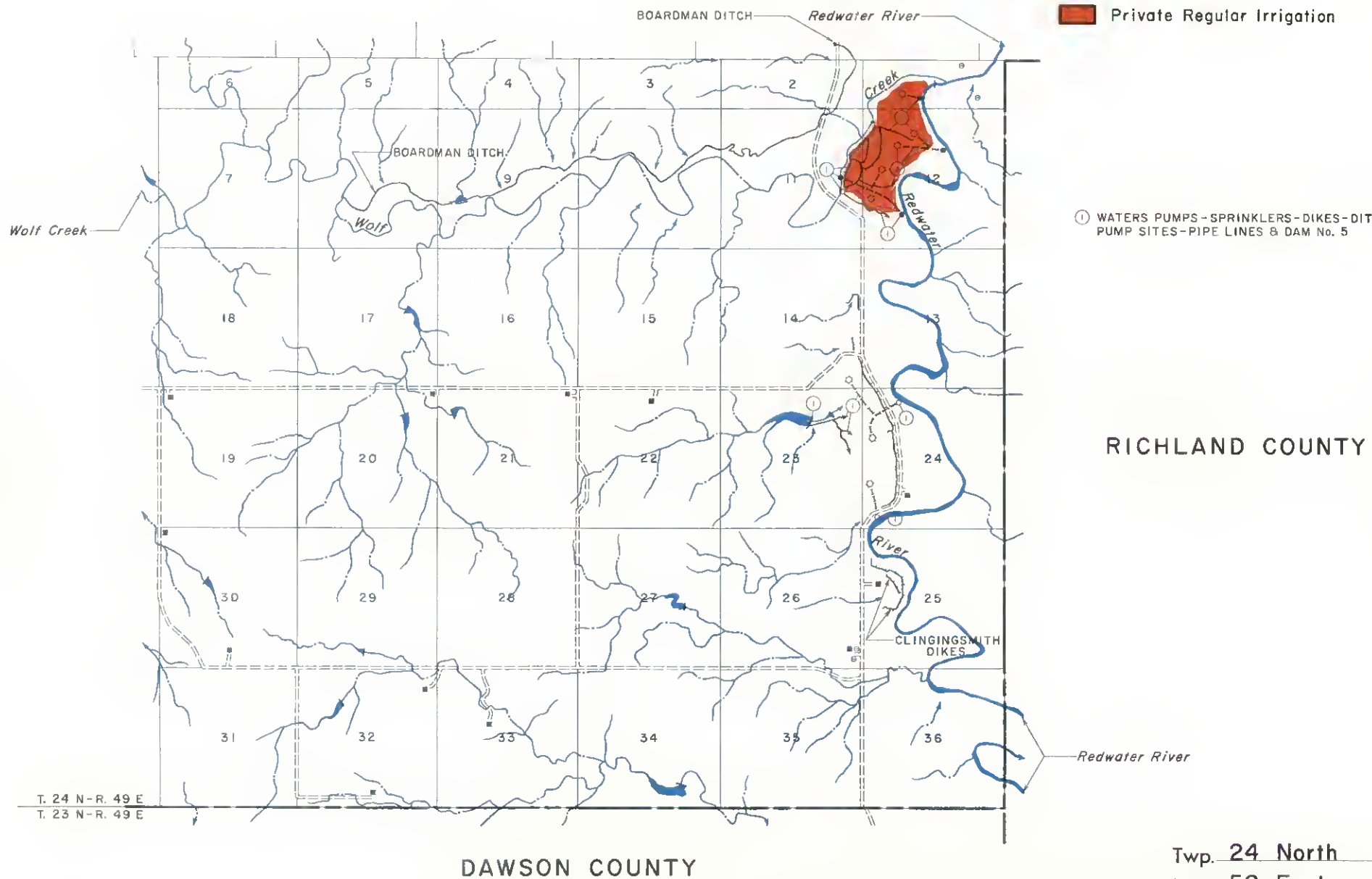
Rge. 47 East

Drafted by Dan Nelson

LEGEND

 Private Regular Irrigation

① WATERS PUMPS-SPRINKLERS-DIKES-DITCHES-
PUMP SITES-PIPE LINES & DAM No. 5



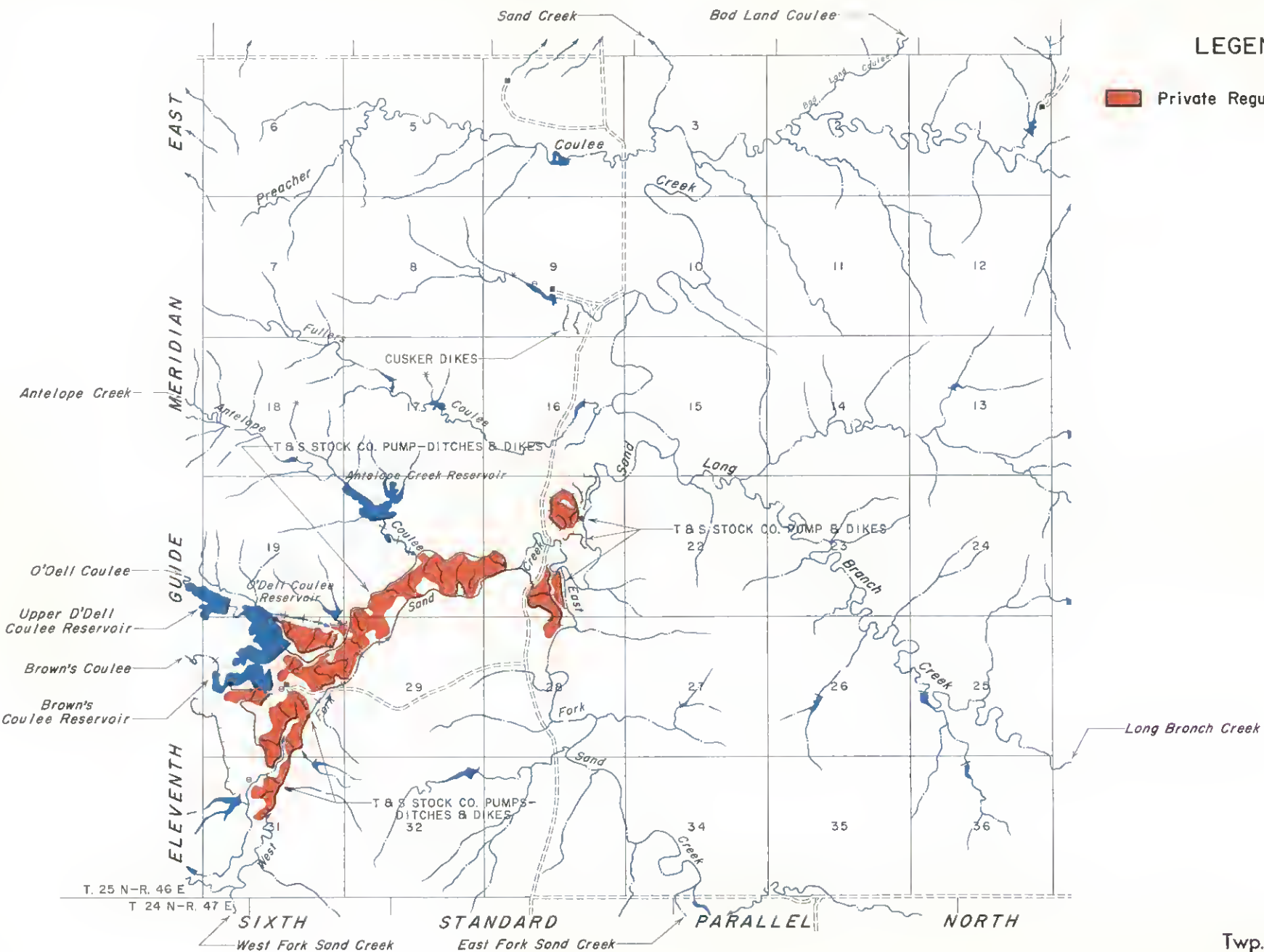
Twp. 24 North

Rge. 50 East

Drafted by Hugh D. Greenup

LEGEND

 Private Regular Irrigation



Twp. 25 North

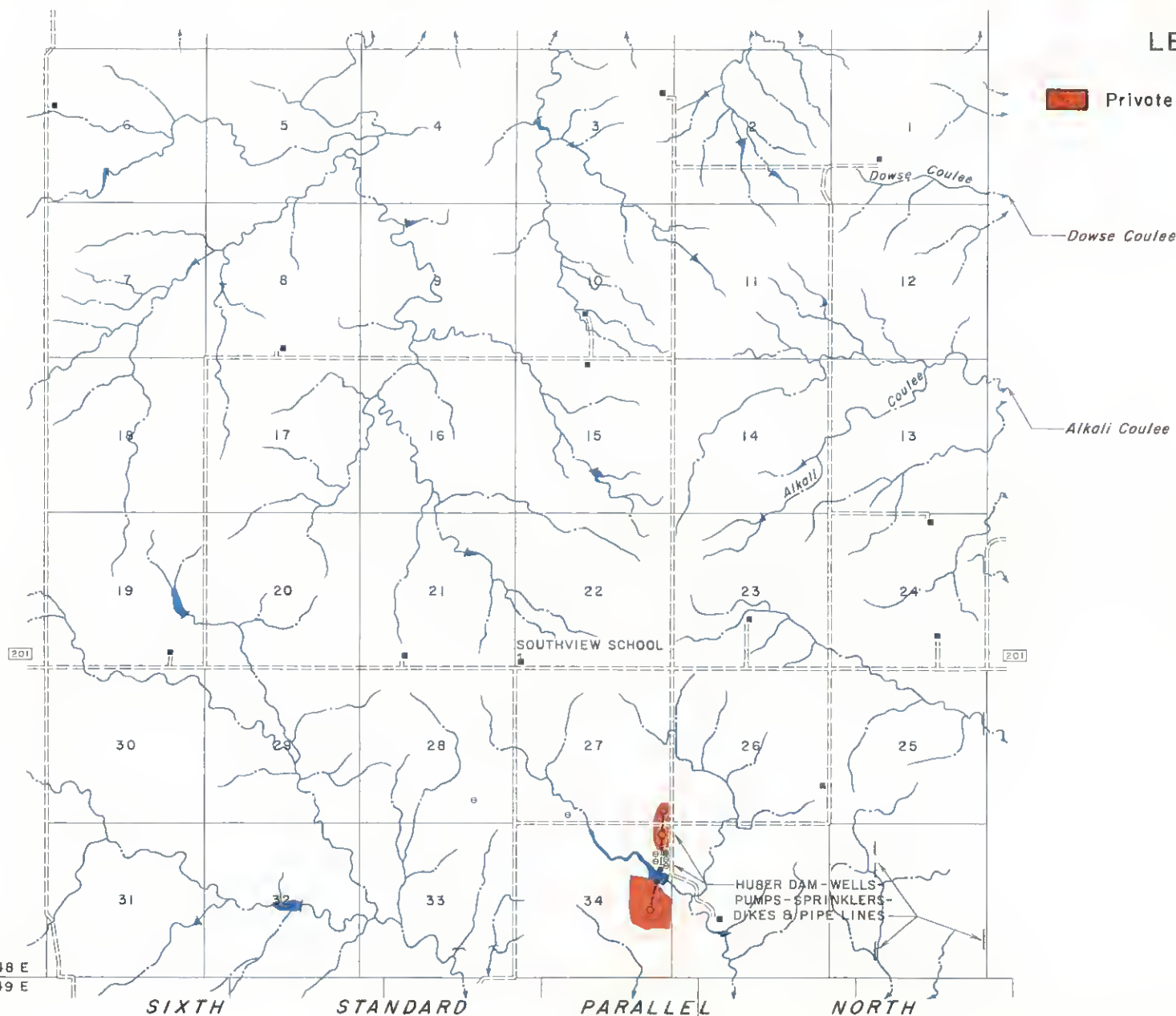
Rge. 47 East

Drafted by Dan Nelson

LEGEND



Private Regular Irrigation

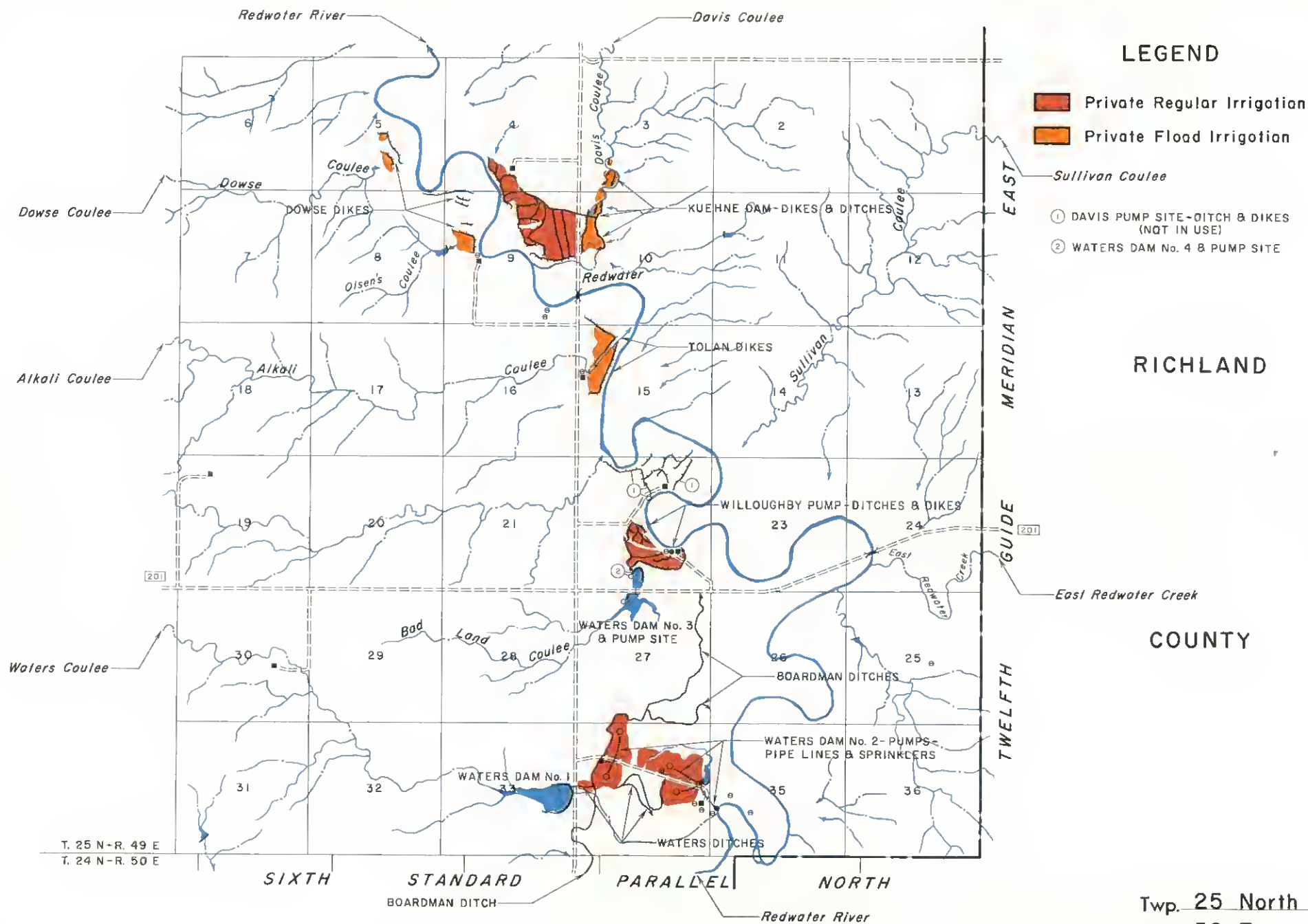


T. 25 N-R. 48 E
T. 24 N-R. 49 E

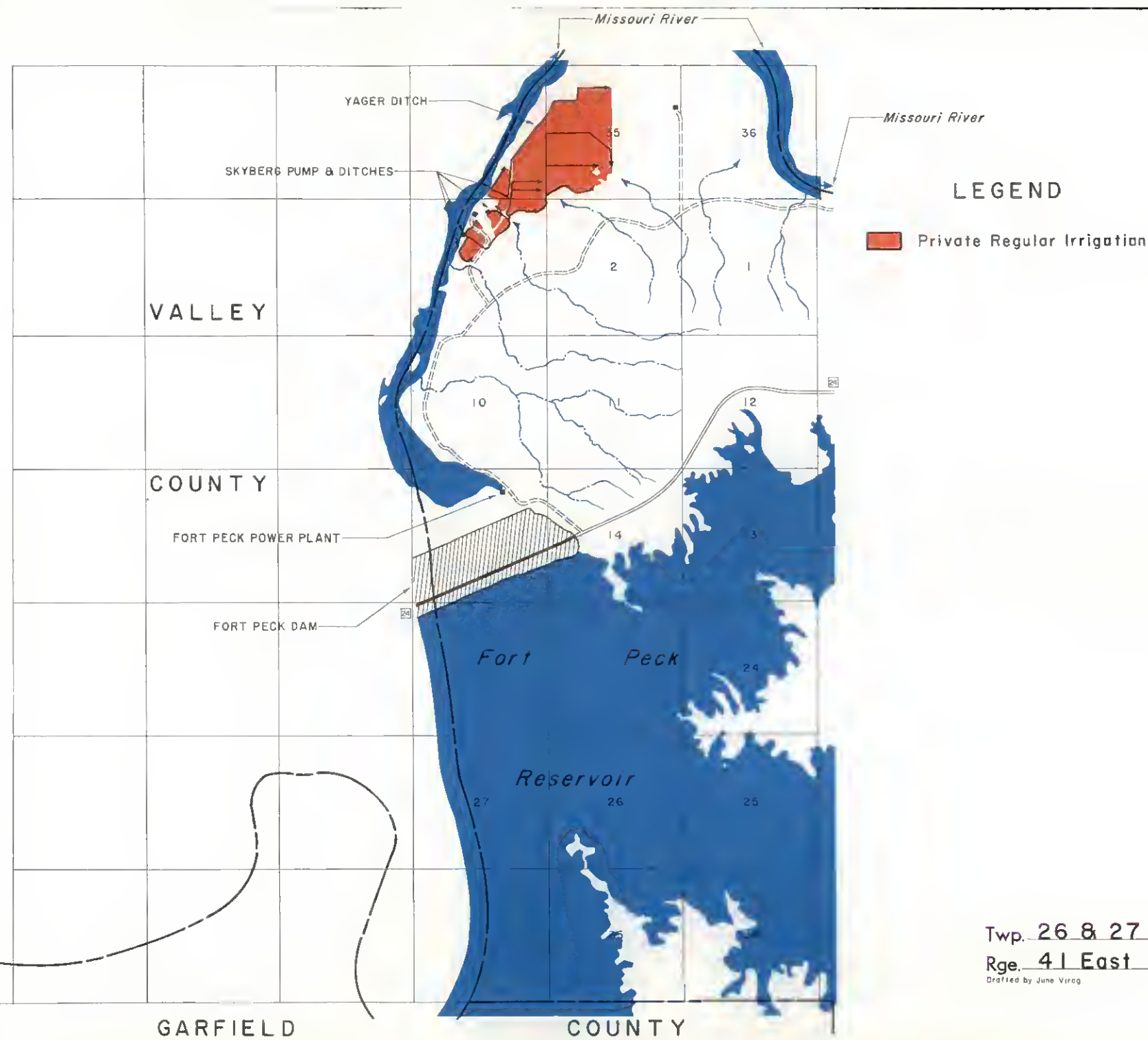
Twp. 25 North

Rge. 49 East

Drafted by Hugh D. Greenup



Twp. 25 North
Rge. 50 East
Drafted by Hugh O. Giesrup



VALLEY COUNTY

LEGEND

 Private Regular Irrigation

Missouri River

6

FORT PECK RESERVOIR
SPILLWAY

NICKELS PUMP & DITCHES

10

11

12

Missouri River

Fort Peck
Reservoir

16

15

14

13

MERIDIAN

19

20

21

22

24

GUIDE

Fort
Peck

29

28

26

25

Lost Creek

Reservoir

33

34

35

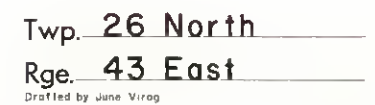
36

TENTH

T. 26 N-R. 41 E
T. 25 N-R. 41 E

Twp. 26 & 27 North
Rge. 42 East

Drafted by June Virag

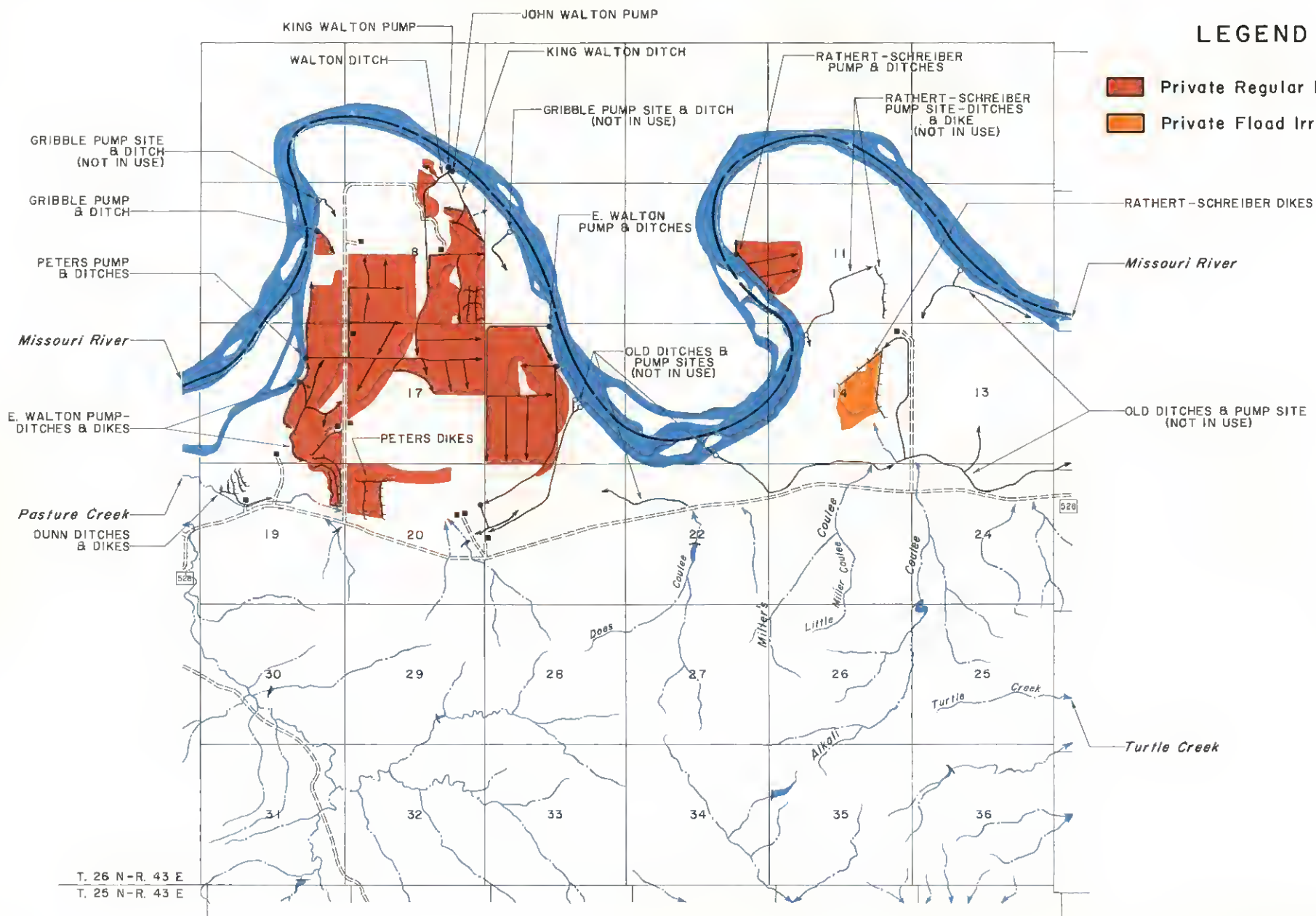
 Private Regular Irrigation

VALLEY

COUNTY

LEGEND

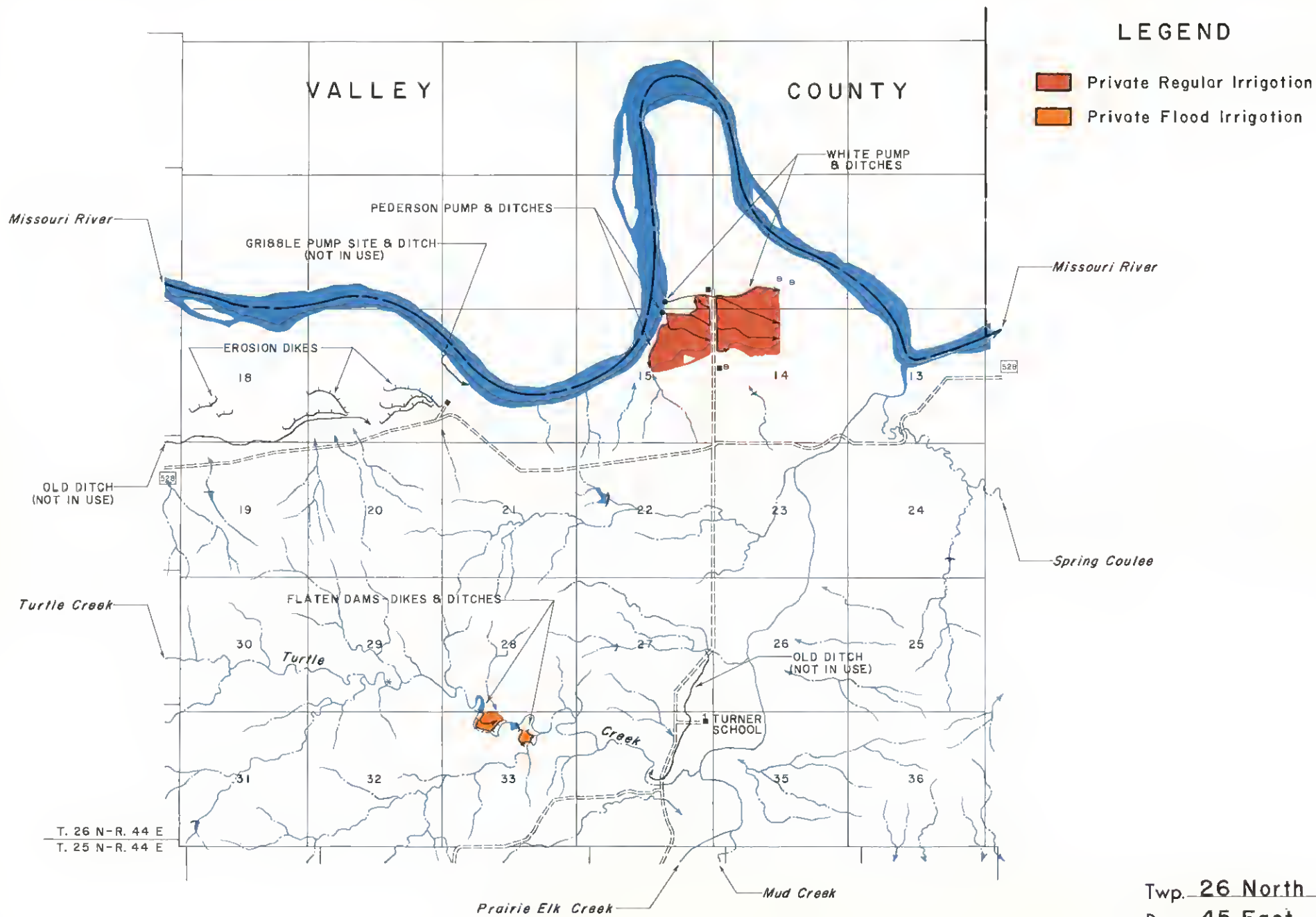
- Private Regular Irrigation
- Private Flood Irrigation



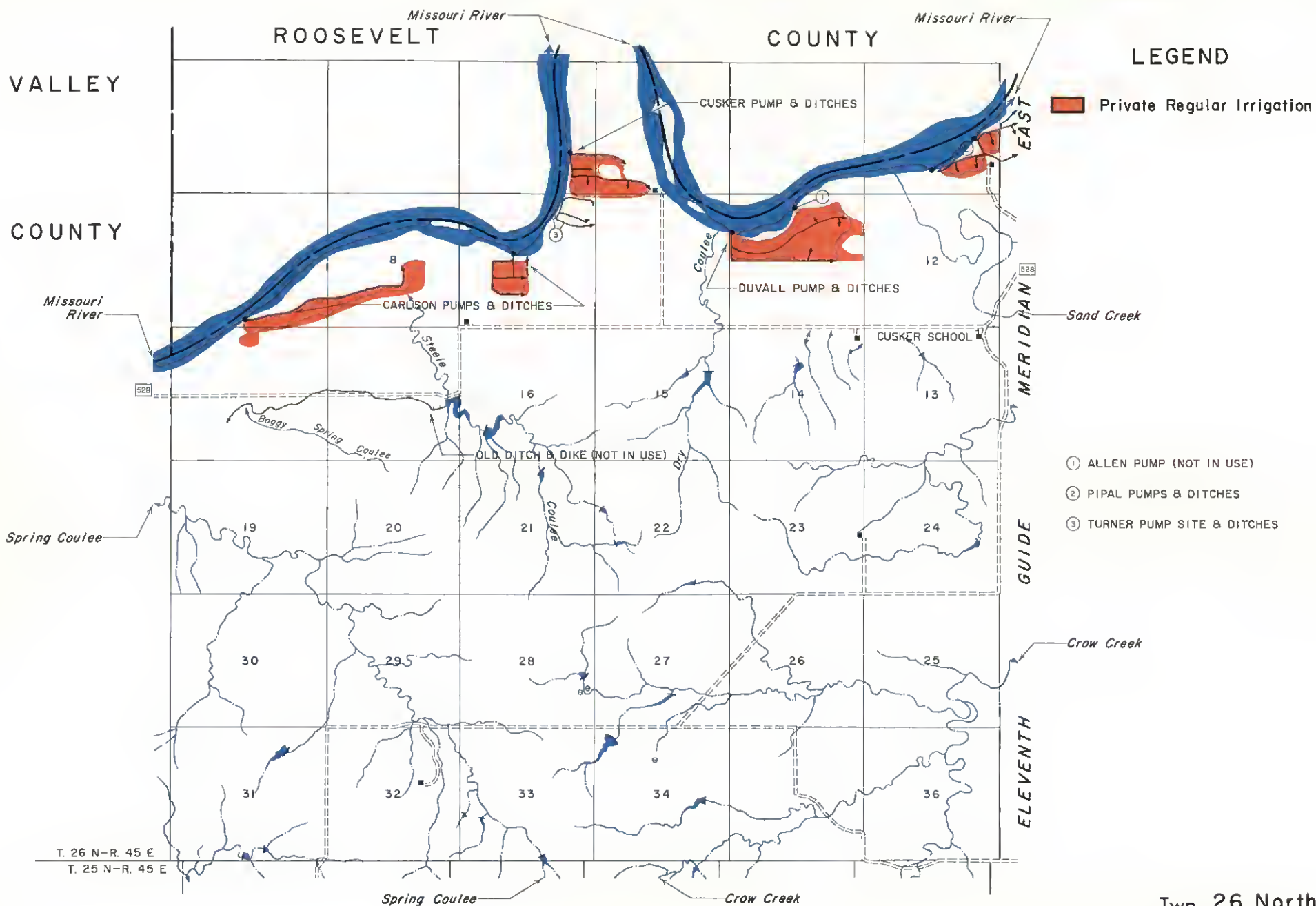
Tw. 26 North

Rge. 44 East

Drafted by June Vrag



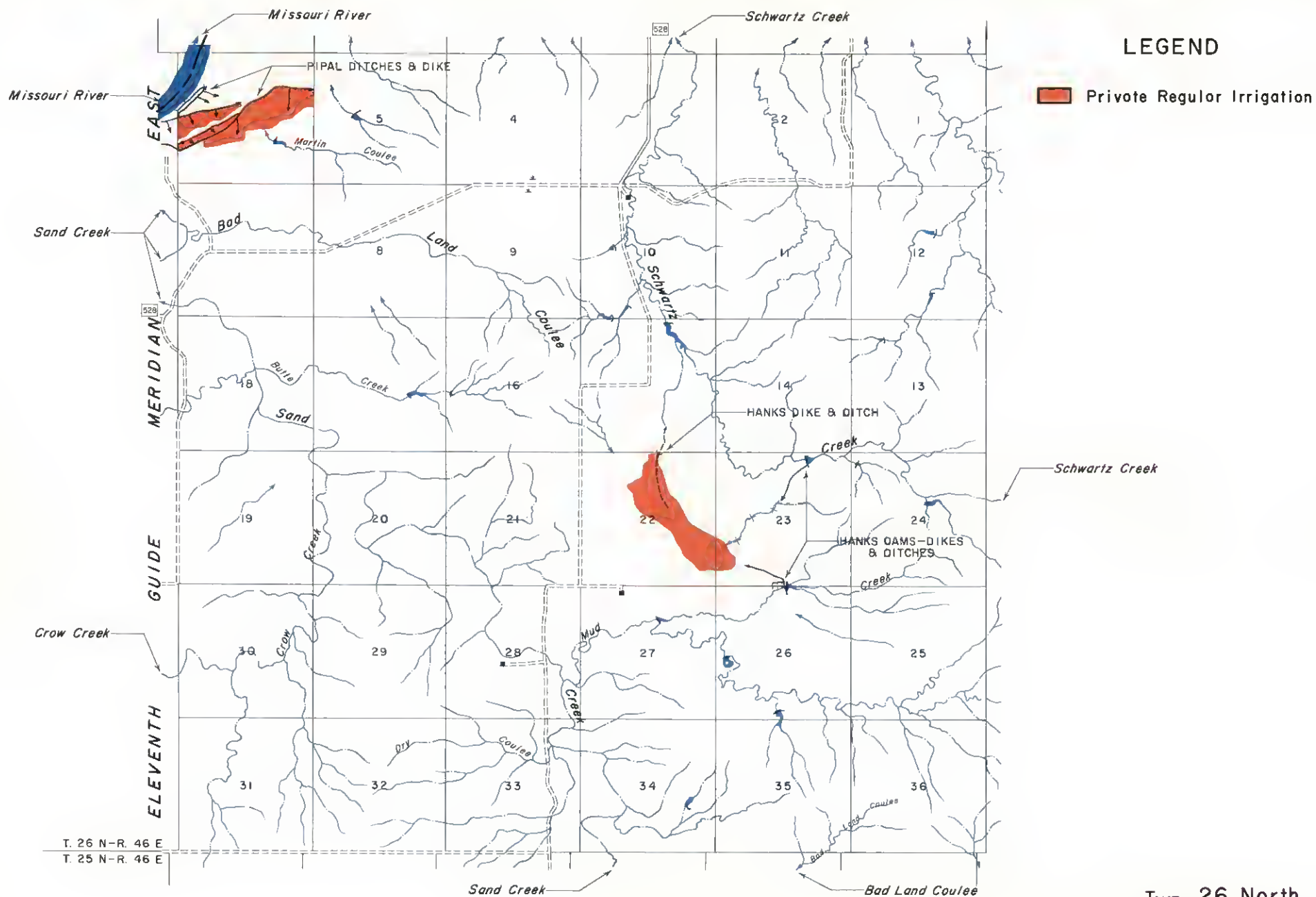
Twp. 26 North
Rge. 45 East
Drafted by June Virag



Twp. 26 North

Rge. 46 East

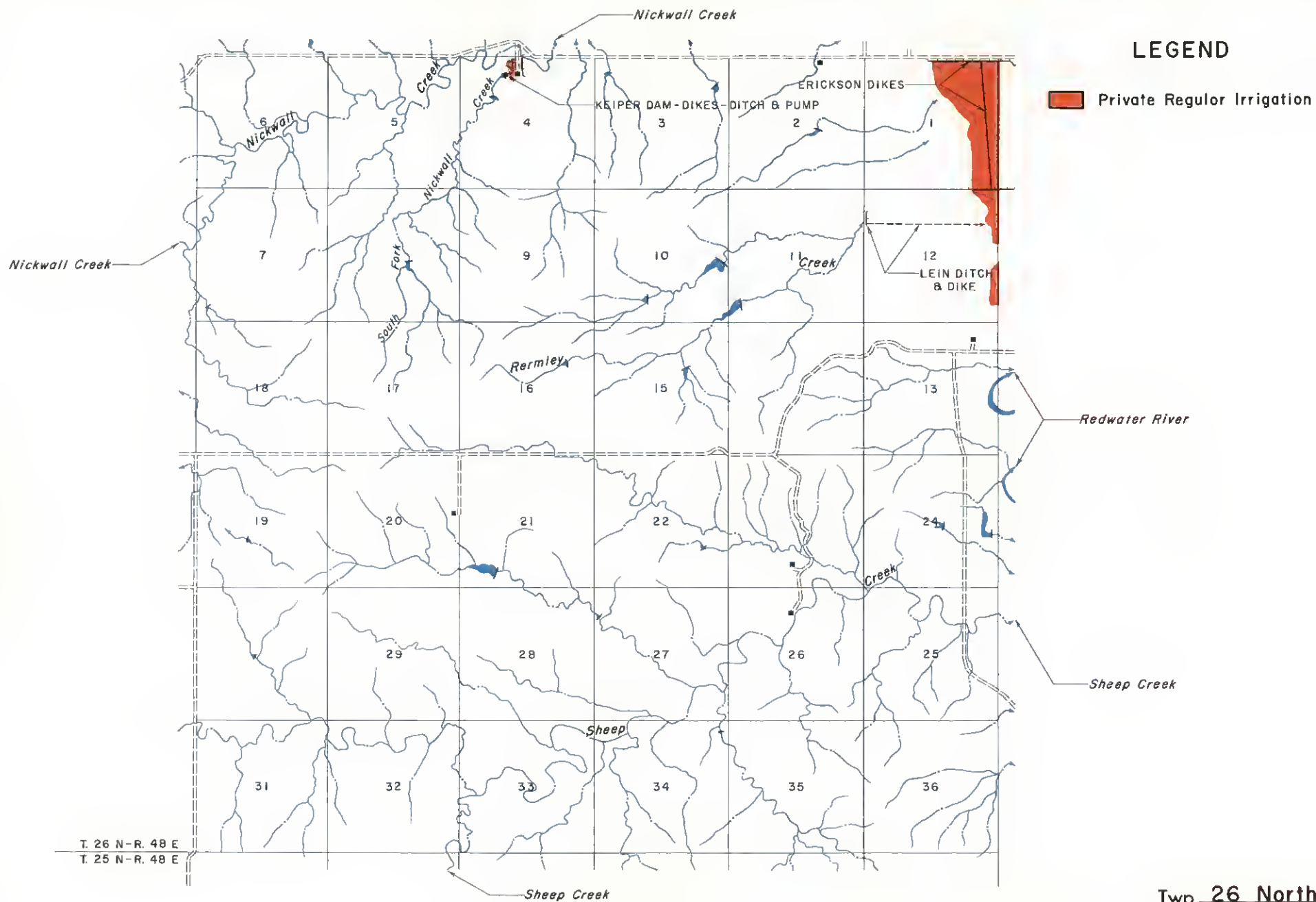
Drafted by Don Nelson



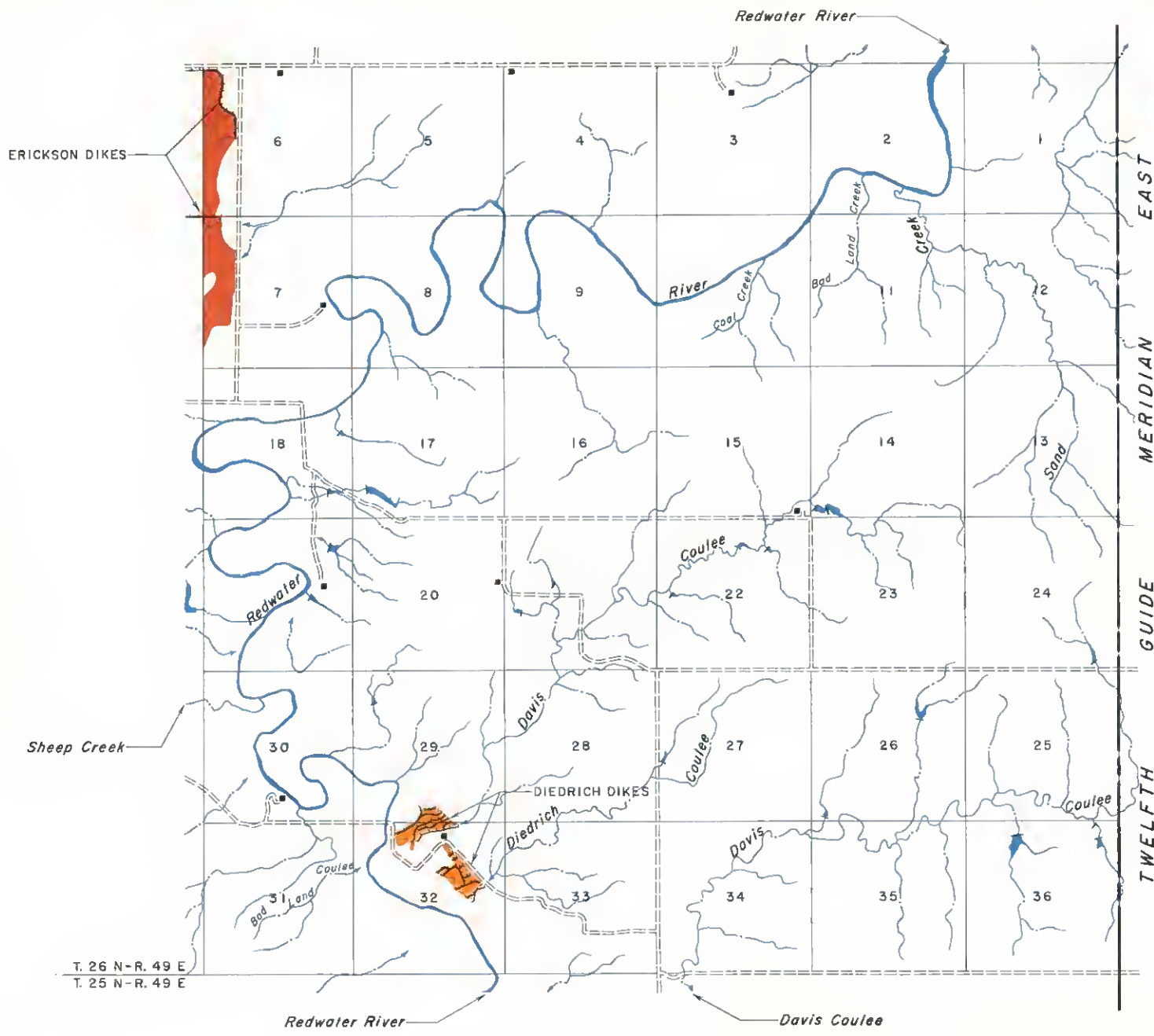
Twp. 26 North

Rge. 47 East

Drafted by Dan Nelson



Twp. 26 North _____
 Rge. 49 East _____
Drafted by Hugh D. Greenup



LEGEND

- Private Regular Irrigation
- Private Flood Irrigation

RICHLAND

COUNTY

Twp. 26 North
Rge. 50 East
Drafted by Hugh D. Greenup

EAST

MERIDIAN

GUIDE

ELEVENTH

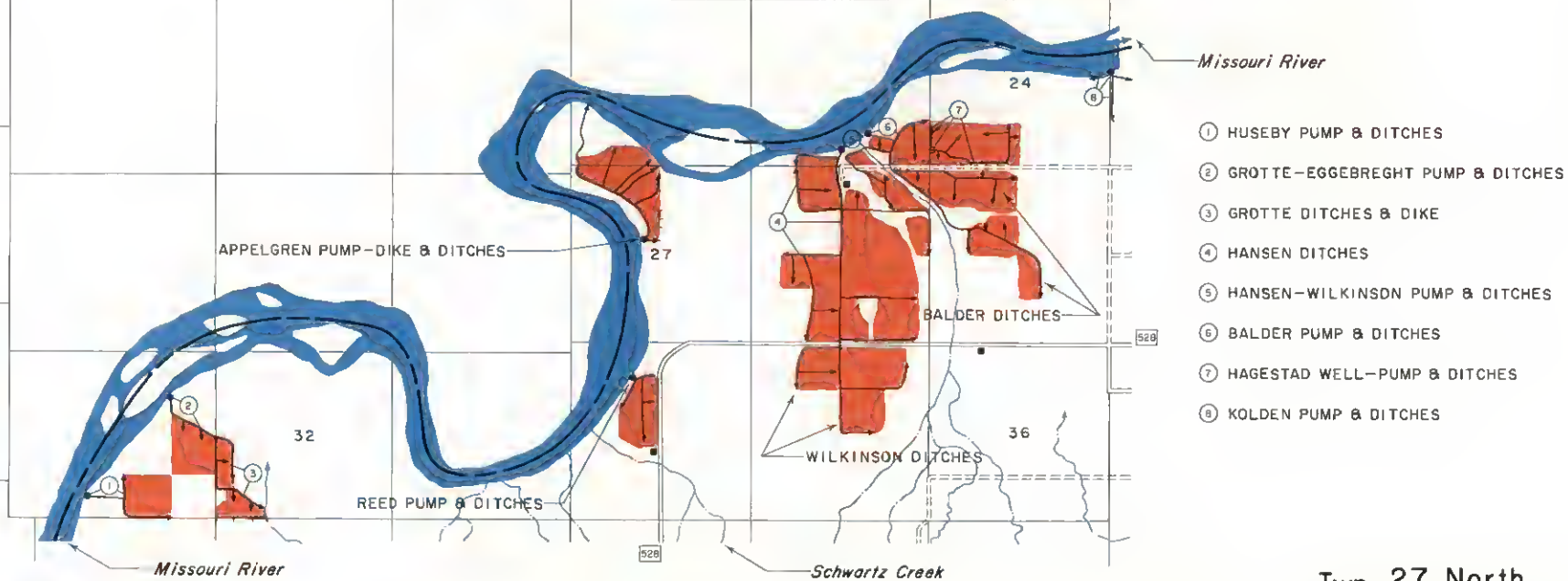
ROOSEVELT

COUNTY

LEGEND

 Private Regular Irrigation

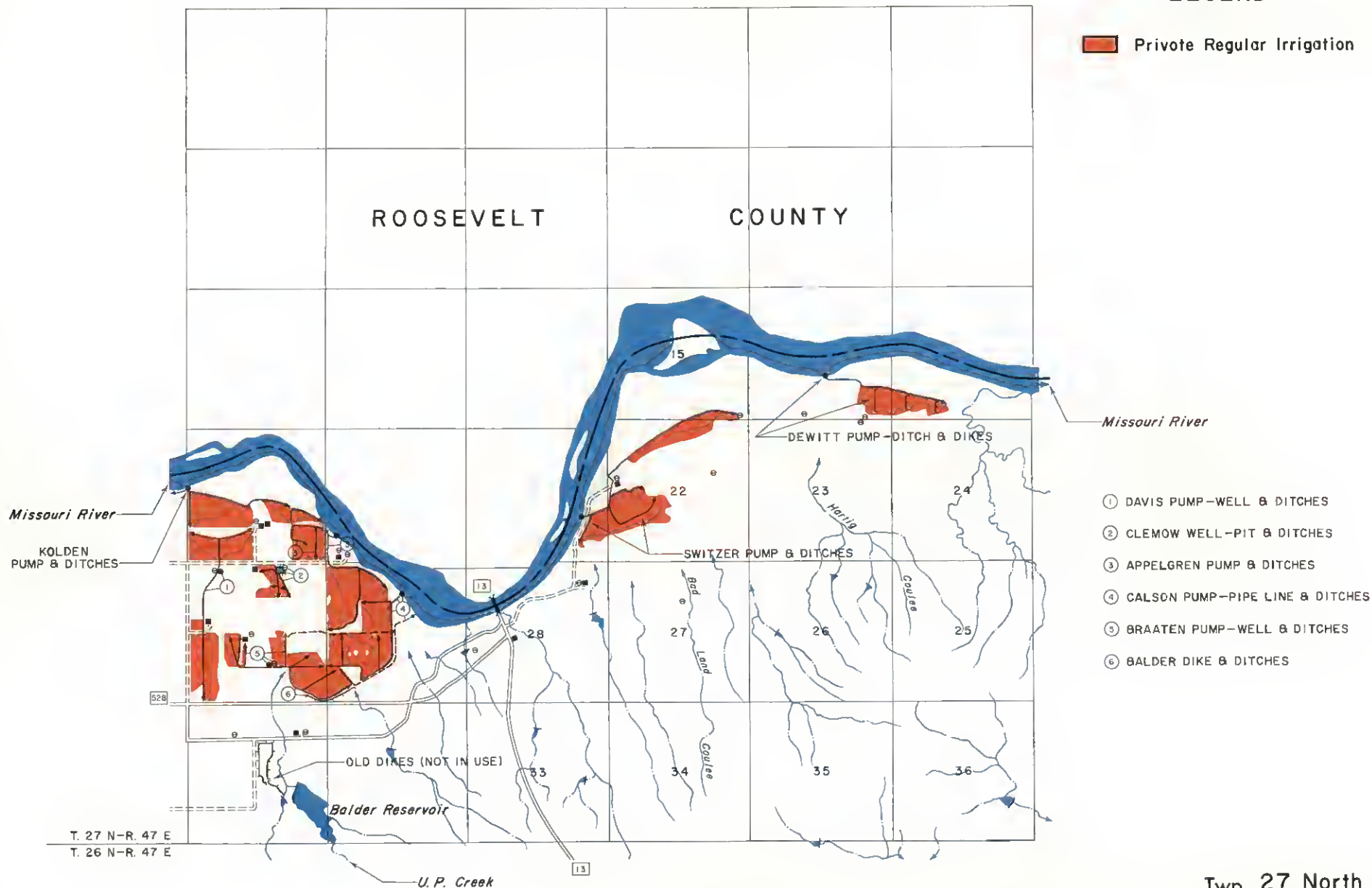
T. 27 N-R. 46 E
T. 26 N-R. 46 E



Twp. 27 North
Rge. 47 East
Drafted by Dan Nelson

LEGEND

 Private Regular Irrigation



Twp. 27 North _____

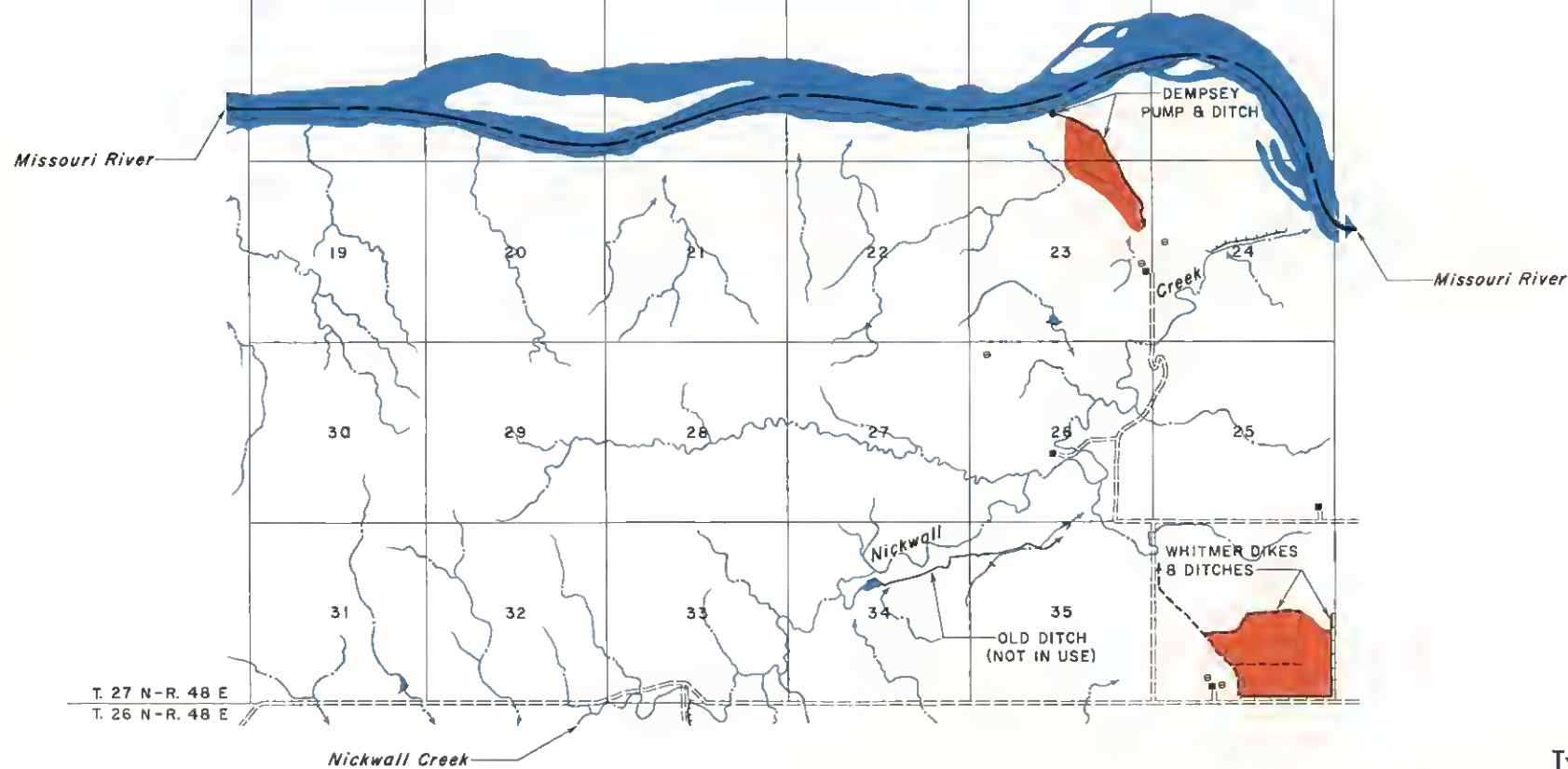
Rge. 48 East _____

Drafted by Dan Nelson

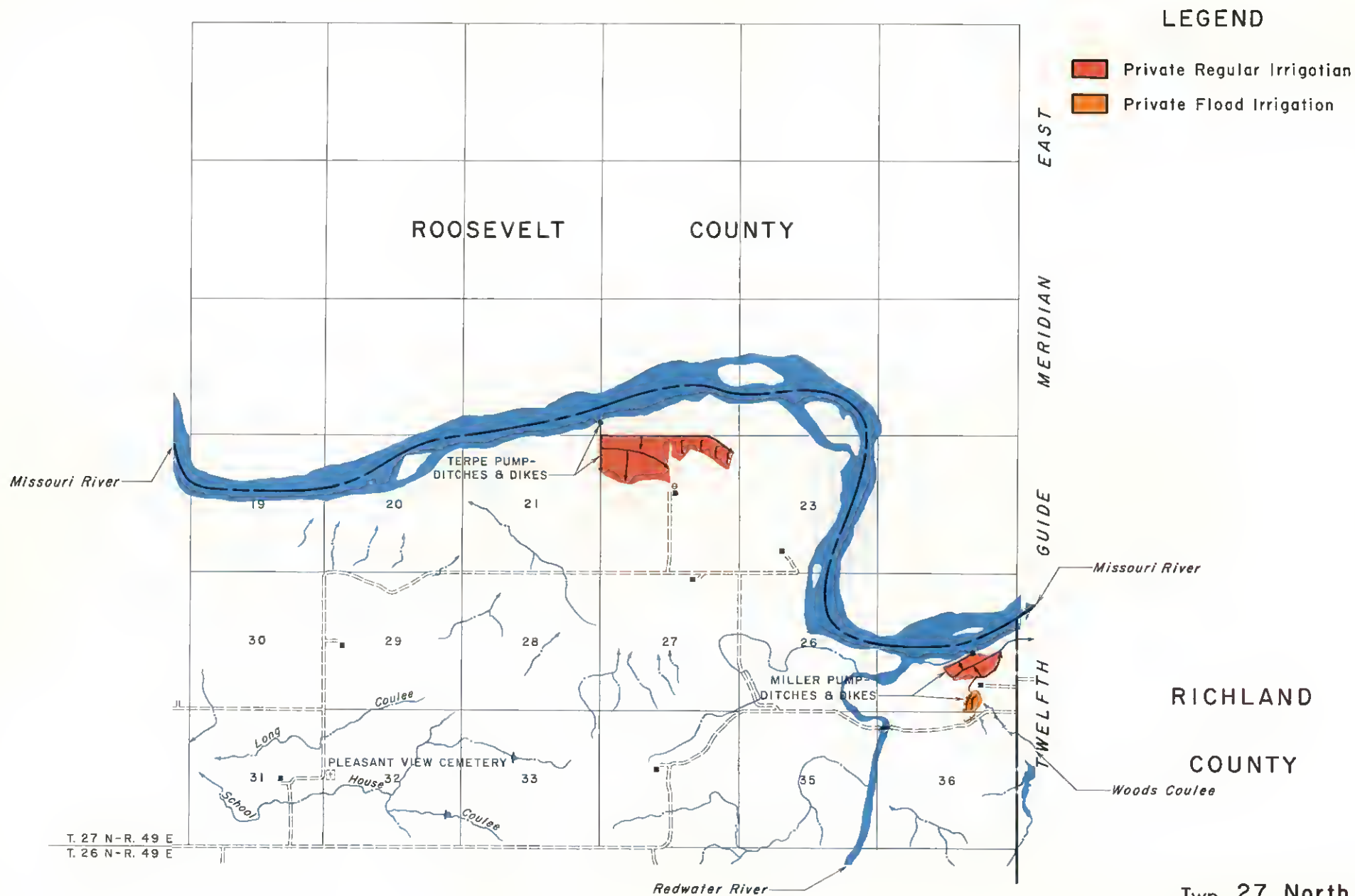
LEGEND

 Private Regular Irrigation

ROOSEVELT COUNTY



Twp. 27 North
Rge. 49 East
Drafted by Hugh D. Greenup



Twp. 27 North
Rge. 50 East
Drafted by Hugh D. Greenup